AMERICAN SOCIETY FOR BARIATRIC SURGERY

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AMERICAN SOCIETY FOR BARIATRIC SURGERY

Proceedings of the meeting of
June 4 and 5, 1984
Iowa City, Iowa

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ABSTRACT
To evaluate the role of extensive preoperative education in improving the selection of candidates for gastric restrictive operations, we established a structured program of preselection education. Only four candidates, referred in writing by their family physicians, were considered each month. They were sent a pamphlet describing the operation, its risks and possible complications, the required changes in diet (intake limited to 600 kcal per day), the necessity to keep explicit food records, and the required increase in exercise. Postoperatively, monthly return visits were required for two years. On the first clinic visit, candidates completed a questionnaire designed to assess their prior knowledge, and, accompanied by a significant other person, heard a lecture emphasizing the necessity that they make a lifetime commitment to weight control. They were taught to blenderize foods and asked to blenderize all food for four weeks. On the second clinic visit, a second questionnaire to evaluate their comprehension was completed. They were interviewed by the nurse-clinician and the surgeon to evaluate their comprehension and to answer questions. Members of the obesity team decided to accept or reject candidates after this visit. Of 19 candidates considered in 10 months, five failed to attend the first clinic after receiving the pamphlet, five failed to return for the second clinic visit, and four were not accepted because of a history of psychiatric admissions, drug use, or lack of insight. We conclude that one half the candidates for gastric restrictive operations will withdraw voluntarily after learning that they must comply with stringent preoperative and postoperative requirements.

Gastric restrictive operations have become a widely used means of weight reduction for morbidly obese persons. Despite the many alterations made to improve the technical integrity of the operation, the selection of patients remains an important factor in the outcome. Halverson reported a 50% rejection rate of candidates on the basis that they would be unable to comply with postoperative requirements or that they failed to understand nutritional principles. Buckwalter emphasized
that the proper selection of candidates for the operation is essential, noting that a positive attitude is the single most important factor. Whelage and Bechtold described a thorough evaluation process that involved an examination completed over a two-month period before psychiatric evaluation which elicited information concerning surgical, obesity, and past medical history. They concluded that serious surgical and psychological complications were eliminated by this evaluation. We describe a structured selection process developed at The Ohio State University to improve selection of candidates for the surgical treatment of morbid obesity.

SELECTION AND METHODS

Methods Upon receipt of a referral letter from a physician, appointments were made by letter to candidates for the two-part selection process. Information regarding medical and obesity history and past weight reduction methods was elicited. The obesity team surgeon contacted the referring physician by telephone to discuss the pamphlet, outline the obesity program at The Ohio State University, and engage his participation in follow-up. Appointments for the first clinic session were made on the basis of medical priority determined by the referring physician's letter and the telephone conversation. Only four candidates were scheduled each month.

The date and time of the appointment were given in a letter sent with the pamphlet, which described simply and concisely the operation, the necessary behavioral and dietary changes, and possible complications. Each candidate was asked to bring a support person and to confirm payment. Both the candidate and the support person were expected to participate in interviews, complete questionnaires, and attend educational sessions. Referring physicians received a copy of the pamphlet and letter.

The first clinic session was three hours long. Interviews and the educational session were conducted by the nurse-clinician. Interviews were structured to elicit information concerning the history of obesity and social factors. Each patient completed a health assessment form. The support person completed a questionnaire designed to elicit the support person's viewpoint of the candidate's readiness to change and ability to cope with change as well as to comply with restrictions.
imposed by the surgical procedure. Support persons participated in group sessions designed to clarify their role.

Upon completion of questionnaires and interviews, candidates and support persons together attended an educational session conducted by the nurse-clinician. Discussed were the operation, possible complications, expected dietary changes and calorie limitations, expected behavioral changes, anticipated outcomes, and psychosocial responses to a reduction in food intake and weight loss. Emphasized was the need for candidates to commit themselves to behavioral changes and the role of the support person in the weight reduction process. Consent forms were reviewed in detail. Each candidate was instructed to record food intake during the month between the first and second sessions according to the following protocol: the first week, all food and beverages with the amount and caloric value of each; the second week caloric intake limited to 600 kcal per day; and the third and fourth weeks all foods blenderized to a liquid consistency with calories maintained at 600 kcal per day. Vitamin supplements were given each day of reduced caloric intake. The candidates were asked to bring these daily records to the second clinic session.

Candidates and support persons attended the second clinic session four weeks later along with patients returning for postoperative follow-up visits. During this session, candidates and support persons were again interviewed by the surgeon, and consent forms were reviewed and signed by candidates and surgeon. The nurse-clinician reviewed food records with each candidate. Candidates were asked to await the outcome of the selection process.

The surgeon and the nurse-clinician reviewed all the data and selected candidates for hospital admission. Candidates were notified of acceptance or rejection within three days of the second clinic session.

Candidates accepted for operation were admitted to the Clinical Research Center at The Ohio State University Hospitals for a GIP meal approximately two weeks before the scheduled operation. The dietitian reviewed the daily food records kept between the first and second clinic session and discussed the basic four food groups. She demonstrated blenderizing of solid foods and distributed a booklet about the liquid postoperative diet. Before hospital admission, each patient underwent an
upper gastrointestinal series and an oral cholecystogram. Patients were admitted one day preoperatively for completion of the physical examination.

Subjects. During a 5-month period, 19 candidates were scheduled for the first session. The six men and 13 women ranged in age from 15 to 65 years, and the mean age was 26.9 years. All were at least 100% over ideal body weight.

Five of the 19 (26.3%) failed to attend the first clinic. Three cancelled their appointments. Reasons varied: one was unable to comply with the monthly follow-up visits because of lack of reliable transportation and the distance; another, after reading the pamphlet, refused to blenderize foods and restrict caloric intake; the third changed her mind about surgical intervention after reading about possible complications. Two candidates simply failed to appear.

Another five of the 19 (26.3%) who did attend the first session failed to attend the second. Two cancelled appointments: one claimed he was not certain he could adhere to the diet restrictions or blenderize his food for eight weeks, and this was confirmed by his support person; another cancelled because her husband believed this effort was doomed to fail and therefore would not support her. She blamed marital discord on her overweight, but she feared the operation, the associated risks, and the dietary restrictions. The other three patients simply failed to appear for the second session.

In all, ten (52.6%) of the 19 candidates who were given appointments for the two-session clinic failed to complete the selection process.

Four (21.1%) of the 19 candidates were not selected to undergo the operation. One was a 15-year-old boy who was unable to state the purpose of the operation or why he wanted to undergo the procedure. He recounted no difficulties in ability to compete with his peers in sports, denied snacking between meals, and reported that he ate only three small meals a day. His mother refuted his claims. He demonstrated little interest in the educational session or in answering questions.

The second candidate refused was a passive, dependent wife and mother whose family relied on her to clean, wash clothes, and deliver meals to them at their workplaces. Rather than expressing anger or frustration, she overate. During the year after her mother died, she
gained 100 pounds. Her husband claimed that despite his help in her previous efforts at weight reduction, she had repeatedly failed.

The third patient expressed a need for narcotics to control constant hunger pain, and believed that the operation would accomplish this. Her referring physician reported that she was neurotic and had been at times almost psychotically depressed, requiring hospitalization. She was observed to be very hostile toward her husband and verbally abused him during the clinic sessions.

The fourth rejected candidate did not identify excessive intake of food as a cause of obesity, claiming that she ate only one meal a day. She believed the operation would automatically count calories and prevent her from eating too much food. Although she identified her husband as her support person, he did not complete the questionnaire until during his interview with the nurse. He fell asleep during the educational session and openly expressed his disapproval of the operation.

Of the 19 candidates, five (26.3%) completed the two-session clinic and were selected to undergo the operation. Two underwent gastro-gastrostomy with a silastic ring 17 months ago without either early or late complications. One has lost 85 pounds, and the other 115 pounds. Three underwent the Roux-en-Y gastric bypass described by Griffen one year ago. Weight loss in two has been 80 pounds and 85 pounds respectively. The third patient died postoperatively from anastomotic leak and subsequent sepsis.

**DISCUSSION**

This protocol was developed after assessment of data collected in over 600 patients who entered the Obesity Clinic. We observed that much time was devoted to the education and evaluation of candidates, and that because of this, postoperative patients were kept waiting to see the surgeon. Candidates were therefore interviewed in a separate group. In accordance with the protocol, approximately two and one-half hours were spent with each candidate. The detailed educational session was well received by both candidates and their support persons. The provision of information in a structured manner enabled them to make informed decisions about the operation.

The interviewing process elicited much helpful information. We had noted in earlier postoperative patients that the lack of a social support
system was common among those who failed to lose weight. Patients less thoroughly prepared undergoing operation less than two weeks after a clinic session claimed that they were inadequately informed about complications or dietary restrictions. Fewer than one half of these patients had a satisfactory outcome.

Restructuring of the information process included evaluation of a support person. More emphasis was placed on lengthening the time between the collection of information and the selection of candidates for operation. The interviewing process was designed to elicit information about surgical procedures, obesity, and past medical history. Selection of candidates to undergo the operation was made only after all information was collected, and the final decision was made jointly by the surgeon and the nurse-clinician.

In the period of five months during which this protocol was followed, over half (52.6%) of the candidates voluntarily withdrew before completing the two clinic sessions. The pamphlet showed in bold type important information such as the 600 kcal limitation, the necessity of daily exercise, and no solid food for eight weeks. Emphasis was placed on the fact that the procedure was not a cure for obesity. We speculate that because some of this information was not acceptable, five candidates failed to appear at the first session.

An additional five patients withdrew after the first clinic session, and we attribute this to the structure of the first session. The nurse-clinician was able to focus on the candidates and their support persons and assess their behavior. Associated risks and realistic results were discussed. The interdiction of solid food for eight weeks was interpreted for each candidate in light of his lifestyle. All of these factors raised the consciousness of each candidate and made each more aware of the ramifications of the surgical procedure.

Because morbid obesity is lifethreatening, the rejection of a candidate for surgical intervention should be made because the risks of operation exceed the expected benefits. Issues such as denial of the cause of obesity, the use of food to cope with stress, or frank psychopathology should be addressed before candidates are accepted for operation, or the outcome will be unsuccessful. This is illustrated by the candidate who stated that she ate a small amount of food a day. If
this were true, she would have technically accomplished the goal of the operation, which is to restrict food intake.

In contrast, candidates selected for surgical intervention sought help to restrict the amount of food they consumed. Each identified a person ready to commit himself to the role of support person, and each anticipated that changes in behavior would be necessary to maintain weight loss.

Although it is too early to determine whether these patients will maintain postoperative weight loss, each has been successful in losing 80 pounds in the first year. The benefits of weight loss are already apparent. Two patients with adult-onset diabetes have discontinued the use of insulin; another has received a job promotion to a top level management position; another patient who has been divorced has recently remarried. He attributed the ability to cope with divorce to be positive change in his self-concept.

We conclude that the two-part clinic session enhanced the selection process. The inclusion of the support person in the educational session and in the evaluation process is important. Extending the interval between selection and admission to the hospital afforded patients the time to assimilate information and make informed decisions. We believe that this selection process will yield a voluntary withdrawal of unsuitable candidates and the selection of those who will benefit from the procedure.

REFERENCES


ACKNOWLEDGEMENTS

The questionnaire used to evaluate comprehension by the candidates was designed by Cheri Florance, Ph.D.
SOCKET WORK SERVICES
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Social work services have been provided to gastric bypass patients at the University of Iowa Hospitals and Clinics in recent years. In 1983 social work services were provided to 202 patients both in the Surgery Outpatient Clinic and the inpatient area. Sixty-seven of these patients received support group services postoperatively on the inpatient area. Patients who come to University Hospitals for surgical treatment of obesity usually come in with various health problems, symptoms, functional limitations, and psychosocial problems. Most of the patients who come in for evaluation meet the usual criteria of at least 100 percent above ideal weight, and may have other health conditions that are aggravated by their obesity, such as, diabetes mellitus, hypertension, pulmonary problems, arthritis, low back pain, knee pain, and cardiac problems.

The psychosocial problems of these patients vary widely, from being unable to walk and dependent upon others for personal hygiene, to suffering social and economic discrimination.

Typically, the social worker makes first contact with these patients during preoperative evaluation in the Surgery Outpatient Clinic. A psychosocial assessment is made at this time. Information is elicited regarding the age of onset of their obesity and what particular problems or events may have occurred at the time of this onset; other family members who may also be obese; current eating patterns including number of meals consumed daily as well as snacking behavior, overeating and binging. A dietary history of various weight loss programs that the patients have attempted, their experience as far as weight loss and what period of time before frustration or boredom set in is also taken. The short-term and long-term changes resulting from the operation are discussed with the patient during the assessment phase. The purpose of the operation and its goals are discussed. Any questions that the patient and his/her family members have are also addressed. (See Psychosocial Assessment Outline.)
The information elicited from the patients and their families during the assessment is recorded in the patient's record and can be referred to whenever necessary. This information can help to focus on goal setting and behavioral changes upon discharge. For example, if a patient reports that he/she drinks a high volume of fluid each day, it will be useful to the social worker to check on any problems he/she may experience postoperatively with sipping fluids. The social worker can then assist the patient in the problem solving process if this, in fact, is an issue.

Another increasingly important aspect of the social work assessment is to elicit concrete third party provider information. This includes both private and government assisted insurance information. Recently, obtaining prior approval from insurance companies has been more difficult, especially for revision procedures and panniculectomies. Some carriers still view panniculectomies as cosmetic procedures and not medically necessary. It is not clear what their reasons for denial are in some cases. Further investigation into these matters may be warranted.

Psychosocial Assessment Outline

I. Demographic Information
   A. Name, age, marital status, children, lives alone or with others, employment. Resources such as: insurance, Medicare, Medicaid, medically indigent.

II. Family History
   A. Other obese family members.
      How is weight a problem such as medical conditions, shortness of breath, low back or knee pain.
   B. Current eating pattern.
      How many meals per day.
      Snacking patterns such as: when, how much, binging and overeating patterns.
   C. Diet history.
      Diet, length of time on a diet, amount weight loss, and why diet was abandoned.
III. Information About the Operation

Discuss purpose of operation for weight loss, family support or lack of it, others who have had it and their experience with it, patient's feelings and motivations, discuss possible changes in current eating pattern to comply with postoperative diet.

In general, the social work role is to elicit third party information and to refer those patients to possible resources depending upon eligibility requirements to the programs such as Medicaid and other programs for medically indigent persons.

Another time of social work intervention occurs postoperatively on the inpatient area. The social worker may see the patient individually or in a group setting during the week of surgery. In the group setting the social worker attempts to bring together all of the patients who have had a gastric restrictive procedure. Together they discuss mutual concerns and expectations upon returning home to family, work, and social situations that in effect have not changed. They discuss need to adjust to changes that will occur for these patients. The social worker attempts to involve these patients during this time in various problem solving techniques. Individual follow-up contact is usually made if a patient has more complicated and/or more immediate concerns during their inpatient stay at the hospital. (See Gastric Bypass Patient Support Group.)

The social worker structures the group, in effect, by introducing a few cognitive-behavioral exercises for group problem solving. One commonly used technique is group "brainstorming" of a particular problem which may be volunteered by a patient.

The social worker encourages group members to offer alternative solutions to the problem by teaching them to not evaluate them until the brainstorming session is finished. The social worker then writes the suggestions on the blackboard. The patient who volunteered the information will evaluate each solution according to their situation. In this manner the social worker teaches the member a new problem solving technique to take home with him/her at discharge.
Gastric Bypass Patient Support Group

STATEMENT OF PURPOSE:

The Gastric Bypass Patient Support Group is organized to offer group services as a means of emotional support for the morbidly obese patient while in the hospital. We are able to provide referrals to other Gastric Bypass Groups and/or other related service agencies at the time of discharge from the hospital.

The group also allows patients to provide feedback to the staff regarding the quality of service rendered in such areas as diet and nutrition, physical and emotional support.

RULES FOR PARTICIPATION:

1) This group is based on voluntary participation. Patients may choose to discuss their concerns. They may also choose not to discuss any subject.

2) We request that participants give the floor to other participants, not allowing conflicting discussions to occur simultaneously. Group leader may remind participants if this occurs.

3) Group leader and participants will respect the confidentiality of group discussion. Information will not be shared with non-participants unless permission is given by the individual to do so.

Another commonly used technique is "cognitive rehearsal." A patient volunteers a problem situation such as, internalizing negative self statements. The social worker then elicits from the patient the self-defeating thoughts or statements such as, "The surgery will never work." The social worker will again brainstorm or elicit self-enhancing thoughts such as, "I will no longer be fat," "You can't say that anymore," "The surgery will work and take time." The social worker will have the patient rehearse these self-enhancing statements and ask for group feedback.

Even though the group membership changes from week to week, the brief experiences of group cohesiveness, such as, members having a common goal of weight loss, the exposure to new problem solving techniques coupled with the anticipation of adjusting to the surgery appears to have some benefits for the patients.

Depending upon individual needs, referrals are made to other self-help groups such as the National Gastric Bypass Association in the
patient's local community as well as visiting nurses and homemaker services. Sometimes referrals are made to other mental health professionals.

The social worker collaborates with other professionals who provide services to these patients. These may include nurses, dietitians, and research personnel. Communication occurs on an informal basis among these individuals. There is some overlap of roles, but the common goal of successful weight loss and positive adjustment to new circumstances after weight loss makes this necessary. Each discipline tries to ensure that patients get the full range of services and interventions as needed during the preoperative and postoperative period.

In summary, patients having surgical treatment for obesity at the University of Iowa Hospitals and Clinics could have contact with a social worker preoperatively and postoperatively. A psychosocial assessment is developed preoperatively by the social worker for further utilization postoperatively. Patients are seen either individually or in a support group to identify problems for solution upon discharge. Referrals are made to community resources at discharge. Collaboration with other services, including nursing, dietary, and research, aids in providing a complete program to these patients.

References

PSYCHIATRIC PROFILE OF MORBIDLY OBESE PATIENTS

Since March, 1981, a psychiatric team has participated in an interdisciplinary clinical research project to explore psychological characteristics of the morbidly obese. This paper presents baseline psychiatric findings and demographic data describing sixty-three candidates for the gastric stapling (gastric partition) operation for morbid obesity and details the methodology of the study.

Our team undertook to screen and follow all patients seen and accepted for surgery by the study's surgeon and nutritionist. Our role was twofold: (1) to exclude prospective candidates judged psychiatrically inappropriate for the operation and (2) to establish baseline clinical and psychological test data on the candidates in order to assist long-term follow-up studies.

We collected demographic data on candidates including age, sex, mental status, employment status, ethnic background, and level of education. Clinical features of candidates which we investigated were: family history of obesity, age of onset of obesity, past psychiatric history, and presence or absence of binge eating. Clinical evaluation was done by psychiatric interview with careful attention paid to possible DSM-III diagnoses. Finally, we investigated psychosomatic, projective, and intelligence parameters of the candidates with a battery of five psychological tests.

In general, the results of our testing and interviews support the commonly-held notion that morbidly obese individuals do not differ psychiatrically from the general population. However, careful analysis of our data raises several suggestive associations among variables. For example, those candidates with a high covert level of psychopathology (i.e. elevated symptom test scores without manifest clinical psychopathology) have a greater frequency of early onset of obesity, a smaller frequency of family history of obesity, and a smaller frequency of family psychiatric history than do those without covert pathology. We also found that intelligence level has a strong direct association with a
candidate's understanding of the operative procedure (as measured by pre- and postoperative stomach drawings), a self-evident finding, but one with important implications for the surgeon with regard to informed consent.

Although our findings support the notion that morbidly obese individuals are psychiatrically unremarkable, they nevertheless raise questions about covert psychopathology, informed consent, compliance behavior, and other similar issues. If the warnings in our earlier pilot work regarding dietary and other compliance behaviors of those postoperative patients prove true, then the baseline identification of surgical candidates at risk for noncompliance and poor long-term outcome becomes essential for clinicians working with these individuals.
EATING TESTS IN CANDIDATES FOR OBESITY SURGERY
John G. Kral, M.D., Ph.D., P. Pritchard, M.S., and H.R. Kissileff, Ph.D.

In order to characterize eating behavior in morbidly obese patients and develop predictors of obesity surgery outcome, 65 morbidly obese patients (16 men) were tested on a Universal Eating Monitor, comparing them to 74 lean controls (15 men). Consumption of liquid or solid meals was covertly measured with respect to quantity and rate of ingestion. Obese men (OM) ate more than lean controls (LM), though no such differences were found for women. Both LM and OM ate more and faster than the women, particularly solid meals (OM: 905 g vs 490 g for obese women).

Twenty-four of the obese patients (4 men) have been followed for more than 8 mos (mean: 18 mos) after gastric restrictive procedures. Patients with less successful weight loss (20% preop BW, n=7) ate twice as fast before operation (122 vs 61 g/min) as the more successful patients (37% preop BW, n=5). Meal size on postoperative eating tests identified patients prone to less successful weight loss. Furthermore, eating tests were diagnostic of failure in patients with operations performed elsewhere, irrespective of present body weight.

It is concluded that eating tests provide valuable information prior to obesity surgery and can serve postoperatively as functional tests of gastric capacity. Sex differences are important for evaluating eating behavior in obese patients.
PATIENTS OVER 50 OR UNDER 20 YEARS OF AGE

Paul W. Moen, M.D., A.B.S.

In June, 1976 a 57-year-old white female was referred to me by an internist for consideration of a gastric bypass for her morbid obesity. She was five feet, seven inches tall and weighed 268 lbs, 124 lbs over her ideal weight of 144 lbs. She had been evaluated at Iowa City and had been turned down for surgery owing to severe hypertension and because she was over the age of 50. At that time I had done one gastric bypass. I explained that she was a high risk, had been turned down by the mecca of gastric bypass surgery, and that my experience with gastric bypass was limited to one patient. After detailed discussions with both the patient and her husband, they both pleaded with me to do the surgery. They accepted the high risks involved because she did not want to continue to live as a morbidly obese woman and wife, in constant fear of a heart attack or stroke. On August 19, 1976, I did a 90% gastric bypass with an anterior loop gastrojejunostomy. She was hospitalized three days before operation for workup and stabilization of her blood pressure. She did well postoperatively and today, nearly eight years later, she maintains a weight of 170 to 175 lbs and takes a minimal amount of medication for hypertension. She recently celebrated her 65th birthday with her husband, children, and grandchildren. She has recently recovered from her second panniculectomy and a Marshall Marchetti procedure.

My experience with this one case indicated to me that morbidly obese patients over the age of 50 could indeed be successful candidates for gastric bypass surgery. In 1977, Printen and Mason reported 36 morbidly obese patients over age 50 who had gastric bypasses. They found that the older patient weight loss was 40% less after two years and the operation mortality was four times greater (19%). They did not recommend gastric bypass in this age group unless for specific reasons.

This report deals with 47 patients over the age of 50 and 9 patients under the age of 20 upon whom I have done gastric bypass and more recently vertical banded gastroplasty. Table 1 shows the age spread of patients over 50 years. Table 2 shows the preoperative medical problems: diabetes, hypertension, gallbladder disease, and musculoskeletal dysfunction and sex distribution, 40 female, seven male, 85% and 15% respectively. Table 3 shows the preoperative weight distribution and
percent of excess weight. Average preoperative body weight of 40 females was 265 lbs or 120 kg. Average preoperative body weight of seven males was 288 lbs or 131 kg, 131 lb average excess weight, or 197% of ideal body weight. Table 4 shows the type of operation used.

Early in the series all patients were admitted two to three days before operation for workup including UGI, GBL, colon and chest x-rays, EKG, pulmonary function studies, CBC, UA, BCP, electrolytes, T3, T4, and TI; consultation with cardiologist and internist if indicated for control of hypertension or stabilization of diabetes; IPPB for clearing of any pulmonary problems; and visits with dietitian, bypass nurse and bypass association counselor. Starting two years ago, all workup has been done in the outpatient setting and the patient is admitted early in the morning the day before surgery for preparation. Colon x-ray was discontinued several years ago unless a definite colon problem could be pinpointed. I have been considering eliminating UGI for some time. Recent articles substantiate this feeling. Earlier admission for control of high blood pressure, diabetes or pulmonary problems is still done. All patients had been morbidly obese for many years and had failed all types of medical dietary regimes. They were all desperate for surgery.

Three early gastric bypasses had a 60-75 ml pouch volume with a 1-1.5 cm anastomosis. All the remainder had a 50 ml or less pouch volume with a 1.0 cm anastomosis. The vertical banded gastroplasty patients all had a 25 ml or less pouch volume with a 5.5-cm Marlex band.

Table 5 shows additional procedures performed concurrently with the stapling procedure. Needle liver biopsy (30), cholecystectomy (12), gastrostomy (with GBP) (31) were the most frequently performed procedures. Omentectomy had a brief spell of popularity, being removed routinely to eliminate any chance of undue traction on the transverse colon and thus indirectly on the anterior gastrojejunostomy. This was discontinued when it was felt that simple division of the omentum at the midtransverse colon accomplished the same purpose. A vagotomy and anterior gastrojejunostomy was done in addition to a vertical banded gastroplasty when a stenosed duodenum was found from a chronic duodenal ulcer.

Postoperative hospital stay ranged from five to twelve days, averaging seven days, slightly longer than with the younger patients.
Complications prior to discharge are seen in Table 6. One patient remained on the ventilator 48 hours because he didn't stop his two to three pack a day smoking habit one month before operation as instructed. The low rate of wound infection can be ascribed to the preoperative preparation with Neomycin and Erythromycin and the prophylactic use of Kefzol at time of surgery and later. The one death occurred when intra-abdominal bleeding started 36 hours after operation and could not be controlled in spite of three trips to the operating room over the next 24 hour period. One death in 47 cases equals a mortality of 2.0% as compared to 0.8% for patients 50 and under. There have been no late deaths. The Armed Forces Institute of Pathology could not rule out an Ehlers-Danlos Syndrome. The lack of anastomotic leaks could possibly be due to reinforcement of the GIA anastomosis and TA30 closure with interrupted 3-0 silk sutures posteriorly and a continuous 3-0 silk anteriorly.

Late complications include three incisional ventral hernias which were repaired and one case of superficial thrombophlebitis which responded to conservative treatment. Two cases required revision for reflux with esophagitis. These were converted to Roux-en-Y gastric bypasses.

Surgery following bypass is shown in Table 7 and includes panniculectomy in eight patients, ventral hernia repairs in three, cholecystectomy in two, vaginal hysterectomy and repair in two, plus the two revisions for reflux.

Weight loss is seen in Table 8 and Table 9. The longest follow-up period was almost eight years. I am concerned about the weight loss in the vertical banded gastroplasty patients over age 50 even though the follow-up time has only reached ten months. A definite trend towards less weight loss in the over age 50 vertical banded gastroplasty patient is apparent. This is being investigated on an individual basis.

I feel that these results justify gastric bypass or vertical banded gastroplasty in patients over age 50 years. There is a higher incidence of hypertension and diabetes and musculoskeletal problems, indicative of the deleterious effects of morbid obesity which in some instances had been present for decades. It adds further evidence to insurance carriers to allow gastric bypass procedures at younger ages to prevent the
development of these problems. The one death, possibly due to a rare congenital anomaly, might not have occurred had her surgery been accomplished at a younger age. It is a helpless feeling explaining to a husband and children that their wife and mother bled to death in spite of all heroic measures.

Careful workup, evaluation, preoperative preparation, stabilization of cardiac, blood pressure, diabetes and pulmonary problems will reduce the risks of surgery but not eliminate them. It goes without saying that meticulous expeditious surgery and attentive postoperative care directed towards the preoperative medical problems will provide success in all but the most unusual circumstances.

Let us continue to educate our skeptical medical cohorts and suspicious insurance carriers to the benefits of gastric bypass, so that the surgery may be performed more and more in the younger age group and prevent the ravages that bring this group to the surgeon.

In 1974 Randolph and Associates first reported on the surgical control of morbid obesity in children by using the jejunoileal bypass in three teenagers and one 11-year-old Prader-Willi patient. Soper, Mason, Printen and Zellweger reported in 1975 on 25 morbidly obese children and adolescents (7 Prader-Willi patients) treated by gastric bypass. In 1980 this experience was updated to 41 patients (11 Prader-Willi patients). With these results as a background, I did my first gastric bypass on a patient under age 20 years in April, 1980. The patient was an 11-year-old female, five feet, five inches tall, 228 lbs, 92 lbs above her optimum weight of 136 lbs. Today, four years later, she is five feet, eight inches tall, and weighs 150 lbs, a loss of 78 lbs. However, she has grown three inches, and her optimum weight now is 147 lbs.

In the past four years, nine patients under age 20 have had gastric bypass or vertical banded gastroplasty. One more patient has been approved by the insurance carrier and two more are awaiting insurance approval.

Table 10 shows age and sex breakdown. These were all genetically normal children.

They averaged 282 lbs or 128 kg body weight before operation which was 189% of ideal body weight or 141% excess weight over ideal weight.
Seven patients underwent gastric bypass and two had vertical banded gastroplasty. All had measured pouches and measured stomas.

Table 11 shows preoperative medical problems and number of bypasses among other family members.

Table 12 shows additional procedures with gastric bypass.

Table 13 shows weight loss of these nine patients.

Gastric bypass or vertical banded gastroplasty are justified operations in adolescents to reverse the ravages of morbid obesity. Pouch and stomal size are as important as for the adult patient. Pediatric evaluation before operation is essential as is parental and peer support. Support from the surgeon is even more important than in the adult patient. Again, we must continue to educate our medical colleagues and insurance carriers as to the benefit of gastric bypass in the adolescent and teenager.

**OVER AGE 50 GROUP**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gastric Bypass</th>
<th>Vertical Banded Gastroplasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>52</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>53</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>54</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>55</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>60</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>62</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1
PREOPERATIVE MEDICAL PROBLEMS

- Diabetes: 10 - 20%
- Hypertension: 42 - 86%
- Musculoskeletal: 40 - 82%

Cholecystectomy before bypass: 12 - 25.5%
Cholecystectomy at time of bypass: 12 - 25.5%
Cholecystectomy after bypass: 2 - 4.0%

Female: 40 - 85%
Male: 7 - 15%

Table 2

AVERAGE WEIGHT

Gastric Bypass

<table>
<thead>
<tr>
<th>Average Weight #</th>
<th>Kilo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female 24</td>
<td>259</td>
</tr>
<tr>
<td>Male 5</td>
<td>282</td>
</tr>
<tr>
<td>Female 16</td>
<td>271</td>
</tr>
<tr>
<td>Male 2</td>
<td>302</td>
</tr>
</tbody>
</table>

Female: 118 Kilo, 193% of IBW
Male: 128 Kilo, 228% of IBW

Vertical Banded Gastroplasty

| Average excess | 131#  |
| Average excess | 59 Kilo|
| Average % of ideal | 197% |

Table 3
### TYPE OF SURGICAL PROCEDURE

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBP &gt; 50cc pouch</td>
<td>3</td>
</tr>
<tr>
<td>GBP &lt; 50cc pouch</td>
<td>26</td>
</tr>
<tr>
<td>VBG 25 cc pouch + 5.5cm band</td>
<td>18</td>
</tr>
<tr>
<td>Revision GBP to Roux en Y</td>
<td>2 (4% revision rate)</td>
</tr>
<tr>
<td>47 patients</td>
<td></td>
</tr>
</tbody>
</table>

Procedures done before 50 and revised after 50

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastroplasty done elsewhere</td>
<td>2</td>
</tr>
<tr>
<td>GBP revised for dilated pouch and dilated staple line</td>
<td>3</td>
</tr>
<tr>
<td>Revision of revision - stenosed anastomosis</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>49 procedures</td>
<td></td>
</tr>
</tbody>
</table>

### ADDITIONAL PROCEDURES WITH BYPASS OR VBG

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle liver biopsy</td>
<td>30</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>12</td>
</tr>
<tr>
<td>Gastrostomy (with GBP)</td>
<td>29</td>
</tr>
<tr>
<td>Omentectomy</td>
<td>8</td>
</tr>
<tr>
<td>Lysis abdominal adhesions</td>
<td>7</td>
</tr>
<tr>
<td>Repair umbilical hernia</td>
<td>4</td>
</tr>
<tr>
<td>Repair postop ventral hernia</td>
<td>2</td>
</tr>
<tr>
<td>Splenectomy</td>
<td>3</td>
</tr>
<tr>
<td>Appendectomy</td>
<td>2</td>
</tr>
<tr>
<td>Avitene pack to spleen</td>
<td>2</td>
</tr>
<tr>
<td>Excision xiphoid</td>
<td>2</td>
</tr>
<tr>
<td>Excision of leiomyoma of stomach wall</td>
<td>1</td>
</tr>
<tr>
<td>Vagotomy and anterior gastrojejunostomy</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 5
COMPLICATIONS

**Predischarge**
- Pleural effusion: 3
- Ventilator 48 hours: 1
- Atelectasis: 4
- Ileus: 1
- Wound infection: 1
- Anastomotic leak: 0
- Dehiscence: 0
- Death - postop bleeding: 1 (Armed Forces Institute of Pathology could not rule out Ehlers-Danlos Syndrome)

Non-related deaths: 0

**Postdischarge**
- Postop hernia: 3
- Thrombophlebitis: 1
- G.E. reflux with esophagitis: 2 (Revised with Roux en Y)

Table 6

**Surgery Following Bypass**
- Panniculectomy: 8
- Cholecystectomy: 2
- Vaginal hysterectomy and repair: 2
- Repair postop ventral hernia: 3
- Salpingo-oophorectomy: 1
- Excision breast mass: 1
- Bilateral high saphenous ligation with upper thigh reduction: 2
- Revision of GBP for reflux: 2
- Marshall Marchetti with panniculectomy: 1

Table 7
COMPARISON OF EXCESS WEIGHT LOSS GBP

<table>
<thead>
<tr>
<th>Age (wk)</th>
<th>GBP 50 and under</th>
<th>GBP over age 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 wk</td>
<td>26%</td>
<td>30%</td>
</tr>
<tr>
<td>6 mo</td>
<td>58%</td>
<td>57%</td>
</tr>
<tr>
<td>1 yr</td>
<td>77%</td>
<td>75%</td>
</tr>
<tr>
<td>2 yr</td>
<td>80%</td>
<td>74%</td>
</tr>
<tr>
<td>3 yr</td>
<td>73%</td>
<td>63%</td>
</tr>
<tr>
<td>4 yr</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>5 yr</td>
<td>68%</td>
<td>69%</td>
</tr>
</tbody>
</table>

Table 8

COMPARISON OF EXCESS WEIGHT LOSS VBG

<table>
<thead>
<tr>
<th>Age (wk)</th>
<th>VBG 50 and under</th>
<th>VBG over age 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 wk</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td>6 wk</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>6 mo</td>
<td>52%</td>
<td>44%</td>
</tr>
<tr>
<td>8 mo</td>
<td>60%</td>
<td>47%</td>
</tr>
<tr>
<td>10 mo</td>
<td>75%</td>
<td>49%</td>
</tr>
</tbody>
</table>

Table 9

AGE GROUP 20 AND UNDER

Age 11 - FF - 2
Age 12 - F - 1
Age 14 - M - 1
Age 15 - MF - 2
Age 17 - M - 1
Age 18 - F - 1
Age 19 - F - 1

6 Females
3 Males
No Prader-Willi cases

Average weight 282# - 128 kilo
189% of IBW or 141% excess weight over IBW
7 GBP, 2 VBG
All measured pouches and measured stomas

Table 10
PRE-OPERATIVE DATA: 20 AND UNDER

Repair undescended testicle and hernia repair
Tonsillectomy
Exploratory lap for polycystic ovaries
Hypertension
Liver dysfunction
Diabetes
Bypass in family:
   Mother
   Mother and father
   Mother, father, and 2 sisters

Table 11

ADDITIONAL PROCEDURES WITH GBP OR VBG

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle liver biopsy</td>
<td>4</td>
</tr>
<tr>
<td>Gastrostomy</td>
<td>7</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
</tr>
<tr>
<td>Wound infections</td>
<td>0</td>
</tr>
<tr>
<td>Pulmonary problems</td>
<td>0</td>
</tr>
<tr>
<td>Deaths</td>
<td>0</td>
</tr>
<tr>
<td>Subsequent surgery</td>
<td>0</td>
</tr>
<tr>
<td>Revisions</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 12

WEIGHT LOSS IN UNDER 20 AGE GROUP

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Height</th>
<th>Pre-op Weight</th>
<th>Ideal Weight</th>
<th>Excess Weight</th>
<th>Current Age</th>
<th>Current Weight</th>
<th>Current Height</th>
<th>Yrs. Since Surgery</th>
<th>Pounds Lost</th>
<th>% of Excess Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>11</td>
<td>5'5&quot;</td>
<td>228</td>
<td>136</td>
<td>92</td>
<td>15</td>
<td>5'8&quot;</td>
<td>150</td>
<td>6</td>
<td>78</td>
<td>85%</td>
</tr>
<tr>
<td>F</td>
<td>12</td>
<td>5'3&quot;</td>
<td>304</td>
<td>128</td>
<td>176</td>
<td>15</td>
<td>5'5&quot;</td>
<td>200</td>
<td>2 1/2</td>
<td>104</td>
<td>59%</td>
</tr>
<tr>
<td>F</td>
<td>11</td>
<td>5'1&quot;</td>
<td>218</td>
<td>115</td>
<td>103</td>
<td>13</td>
<td>5'4&quot;</td>
<td>150</td>
<td>2 1/2</td>
<td>68</td>
<td>66%</td>
</tr>
<tr>
<td>F</td>
<td>15</td>
<td>5'4&quot;</td>
<td>234</td>
<td>132</td>
<td>102</td>
<td>17</td>
<td>5'4&quot;</td>
<td>142</td>
<td>2 1/2</td>
<td>92</td>
<td>90%</td>
</tr>
<tr>
<td>M</td>
<td>14</td>
<td>5'8&quot;</td>
<td>320</td>
<td>156</td>
<td>164</td>
<td>16</td>
<td>5'9&quot;</td>
<td>227</td>
<td>1 1/2</td>
<td>93</td>
<td>57%</td>
</tr>
<tr>
<td>F</td>
<td>19</td>
<td>5'5&quot;</td>
<td>285</td>
<td>135</td>
<td>150</td>
<td>20</td>
<td>5'5&quot;</td>
<td>190</td>
<td>1 1/4</td>
<td>95</td>
<td>63%</td>
</tr>
<tr>
<td>M</td>
<td>15</td>
<td>5'10&quot;</td>
<td>313</td>
<td>160</td>
<td>153</td>
<td>16</td>
<td>5'10&quot;</td>
<td>200</td>
<td>1</td>
<td>113</td>
<td>74%</td>
</tr>
<tr>
<td>M</td>
<td>17</td>
<td>5'9&quot;</td>
<td>283</td>
<td>160</td>
<td>123</td>
<td>17</td>
<td>5'9&quot;</td>
<td>210</td>
<td>6 mo.</td>
<td>73</td>
<td>59%</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>5'7&quot;</td>
<td>350</td>
<td>144</td>
<td>206</td>
<td>18</td>
<td>5'7&quot;</td>
<td>290</td>
<td>4 mo.</td>
<td>60</td>
<td>29%</td>
</tr>
</tbody>
</table>

Table 13
CLASSIFICATION OF RESULTS

Robert E. Brolin, M.D., Daniel P. Greenfield, M.D., M.P.H., Karen Kasnetz, R.D., Lynn Clemow, M.A.

Although the concept of surgery for morbid obesity was introduced nearly 30 years ago, there is presently no standardized method for interpretation of postoperative results. Early reports of results after jejunoileal bypass for obesity by Payne, Salmon, and Scott, were purely anecdotal and did not attempt to define specific criteria for success in terms of weight loss.\(^1\)\(^2\)\(^3\) In the mid-1970s, Mason and Griffen independently reported their results with gastric bypass for morbid obesity and expressed weight loss as the average (mean) for their entire series without specifically defining criteria for success.\(^4\)\(^5\) As stapled gastroplasty became a popular method of treatment for morbid obesity in the early 1980s, several bariatric surgeons defined their own criteria for successful weight loss. In 1982, Freeman defined success as "a loss of greater than 15% of preoperative weight" and found that more than 50% of his gastroplasty patients failed to sustain this much weight loss.\(^6\) In his 1981 evaluation of four techniques of stapled gastroplasty, Maclean considered a loss of \(\geq 25\%\) of preoperative weight a "satisfactory" result and, in addition, considered any patient whose weight loss brought them within 30% of their ideal weight as a "good" result.\(^7\) All of MacLean's patients who did not lose 25% of their preoperative weight were considered "unsatisfactory" results. In his prospective clinical comparison of gastroplasty and gastric bypass, Pories considered a loss of \(\geq 25\%\) of preoperative weight as a success.\(^8\) Halverson used percentage of excess weight loss rather than percentage of preoperative weight loss in assessing his results with loop gastric bypass and considered patients who lost \(\geq 50\%\) of their excess weight to be successful.\(^9\) Among the papers presented during the past three years at the Bariatric Surgery Colloquium, weight loss results were expressed as percentage of preoperative weight lost in seven papers, percentage of excess weight lost in seven papers while nine papers which discussed postoperative weight loss results made no attempt at defining success. Presently there is no uniformly accepted method of defining success in terms of weight loss after gastric reduction surgery.
In addition to lack of uniformity in defining success after gastric reduction operations, conventional methods of reporting weight loss results such as percentage of preoperative weight loss or percentage of excess weight loss tend to favorably misrepresent the end result in the heaviest patients. Losses of either > 25% of preoperative weight or > 50% of excess weight have been the most commonly used numerical criteria for defining successful weight loss after bariatric operations. The following hypothetical patients show how both of these methods can favorably misrepresent the end result. A five foot, four inch, 400-lb woman whose ideal body weight is 125 lbs would be considered successful at 300 lbs after losing 25% of her preoperative weight or at 263 lbs after losing 50% of her excess weight. A woman of this same height and ideal body weight weighing 300 lbs would be considered a success at 225 lbs after losing 25% of her preoperative weight, which is still 100 lbs over her ideal weight. The same patient would weigh 213 lbs after losing 50% of her excess weight. A woman of the same height and ideal body weight weighing 250 lbs prior to gastric reduction surgery would weigh 188 lbs after losing either 25% of her preoperative weight or 50% of her excess weight and, at the same time, be within 50% of her ideal body weight. Hence, conventional parameters used in defining successful weight loss after gastric reduction surgery tend to discriminate in favor of the lighter morbidly obese patients and misrepresent the end results in the heaviest morbidly obese patients.

Since the minimum weight limit for definition of "morbid" obesity is based upon ideal body weight, it would seem logical and appropriate that postoperative weight loss results be based on the same criterion. The primary objective of gastric reduction operations is prevention or amelioration of obesity-related medical disorders such as hypertension, diabetes, degenerative arthritis and progressive cardiorespiratory disability. It would therefore seem appropriate that any method for classification of postoperative results also account for the response of associated medical problems to the weight loss afforded by the operation. The proposed classification system accounts for both absolute weight loss and response of obesity-related medical problems to the weight loss. We have applied the proposed new classification method to the results of our
experience with suture reinforced horizontal gastroplasty as shown in Table 1.

### TABLE 1

| CLASS  | # Patients/|%
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 30% over ideal wt, medical problems resolved</td>
</tr>
<tr>
<td>B</td>
<td>&lt; 40% over ideal wt, medical problems improved/resolved</td>
</tr>
<tr>
<td>C</td>
<td>&lt; 50% over ideal wt, medical problems improved/resolved</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 50% but no longer 100# over ideal wt, med prob improved</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 100# over ideal wt or medical problems unimproved</td>
</tr>
</tbody>
</table>

At this writing, 42 of 56 patients have continued with postoperative follow-up study and have reached a stable weight after the operation. Eight patients have either been lost to follow-up study or have withdrawn from our program. The remaining six patients are still losing weight. Twenty-eight of the 42 patients (67%) had obesity related medical problems prior to operation. Following the operation, medical problems were improved in 18 patients and completely resolved in ten patients. Medical problems were considered resolved when patients were asymptomatic and no longer required medications and were considered improved when problems were controlled on reduced medications. The proposed classification system reads like a report card. Classes A, B, and C are considered successful results by all criteria. Class A represents an excellent result. The seven patients in our series who achieved this degree of weight loss no longer appeared to be overweight. Class B represents a good result both in terms of weight loss and amelioration of obesity-related medical problems. Patients in Class B look a little "chubby" but have markedly improved exercise tolerance and general life-style as a result of their weight loss. Class C represents a satisfactory result both in terms of weight loss and improvement of related medical problems. Quality of life is also notably improved in this group of patients. We arbitrarily selected 50% over ideal weight as the minimum criterion for successful weight loss both because it is an easily remembered figure and because this degree of weight loss is associated with a substantial reduction in obesity related morbidity according to life-table statistics. Class D represents success in
terms of amelioration of obesity-related medical problems in combination with less than adequate weight loss. This is an interesting and important group of patients. It is known that a substantial number of morbidly obese patients achieve significant improvement of obesity-related medical problems with a relatively modest degree of weight loss. Certainly this has been our experience. Virtually all of our Class D patients noted substantial improvement in their life-style because of increased exercise tolerance and reduced need for medications. Class D discriminates in favor of lighter morbidly obese patients in that a modest degree of weight loss could be expected to have greater impact on life-table morbidity than the same weight loss in a heavier patient. Class F represents absolute failure either in terms of weight loss or in terms of amelioration of obesity-related medical problems. Nine of 12 patients who were classified as failures were greater than 150% over ideal weight prior to operation. The heaviest patients must lose a considerably greater amount of weight to achieve success after obesity operations. Although a number of patients in Class F exhibited notable improvement of obesity-related medical problems, we suspect that this improvement will be transient and will have a minimal long-term impact on life-table morbidity statistics. Several patients who have regained a portion of their lost weight have also shown worsening of underlying medical problems.

The number of classes included in the proposed system may make its use somewhat cumbersome. On the other hand, it is important to make a clear distinction between success and failure both in terms of absolute weight loss and amelioration of obesity-related medical problems. The proposed classification method satisfies those criteria. Of the five classes, Class B is probably the least necessary as it merely represents a middle ground between an excellent and satisfactory result. Class D represents an important group because these patients have unequivocally benefited from their operation despite a relatively modest degree of weight loss. In terms of weight loss, success or failure after bariatric operations should be based upon the patient's postoperative weight at the time of stabilization as compared with ideal body weight. In reporting results of a large series of bariatric operations, it is important to
account for the number of individual successes and failures among the total number of patients. This sort of reporting is particularly critical in the evaluation of a new operative technique. Reporting results as an average or mean quantity of weight loss for a large number of patients does not account for the number or percentage of successful results within that particular clinical experience. Valid assessment of outcome of bariatric operations can only be satisfactorily accomplished after establishment of a standardized method for reporting results.

REFERENCES

Discussion of Selection and Postoperative Evaluation, Dr. John Kral, Moderator of Session.

KRAL: The classification problem is extremely important for all of us. We have to know what ideal weight we're talking about, what is appropriate. I would like to stress that we have to consider what is complicated obesity versus a simple overweight problem.

QUESTION: Dr. Moen said the patients over 50 years old with vertical banded gastroplasty would not comply. What does he mean by that?

MOEN: My three oldest patients, aged 59, 61 and 62, have been obese all of their lives and they are finding it more difficult to comply with the three small meals per day requirement. All three were nibblers preoperatively and they are finding it increasingly difficult to control the snacking and the nibbling.

QUESTION: Is obesity an organic problem or is it a behavioral problem?

BROLIN: In my opinion the behavioral problem precedes the organic problem. These people are morbidly obese because they eat too much, and I would consider that more a behavioral disorder. The so-called organic disorder of morbid obesity is a direct result of the eating behavior disorder.

GREENFIELD: I agree with Dr. Brolin. There are very few genetic or endocrinologic syndromes associated with morbid obesity. The patients who have done well in our series have been able to adapt successfully to behavioral changes in their eating patterns.

KRAL: Obesity may be caused by various syndromes. Certainly the well-defined, clearly organic etiologies, are rare, as just pointed out. However, it's quite obvious that there are extreme physiological responses that do participate in perpetuating the obese state once it has been established. There is a behavioral problem but there is most certainly and definitely an organic problem.

DRENICK: I think we shouldn't talk about success or failure unless we state that we have a certain follow-up period in mind, and in my opinion a minimum of three years would be required before we even consider making a judgment. I think we forget that patient satisfaction, regardless of technical perfection, regardless of presence or absence in the doctor's opinion of ill effects, has to be taken into consideration. We know there are any number of patients who fulfill all the criteria of success
that have been listed and still will not stand for the operation and demand that the operation be dismantled.

KRAL: Obviously the quality of life and duration of follow-up study are extremely important.

BROLIN: I agree wholeheartedly. Our results were based upon a weight stabilization, and certainly all of these operations need to stand the test of time.

O'LEARY: I would like to ask Cathy Mojzisik what happened to the 52% of patients that they rejected from their program?

MOJZISIK: Unfortunately we only followed up on a few of them and found that three did seek a procedure by another physician. One individual had a very successful outcome; the other two did not. I don't know what happened to the others. It is difficult to follow them up once you have refused them the operation. Nonetheless we think we were very justified in refusing these individuals.

LAWS: In my experience, men seem to have done better than women, but Ms. Pritchard's data seem to indicate otherwise. Can you comment on this?

PRITCHARD: We have very few men in our studies, but the ones that we have are the ones that ate the most. They simply lost the least amount of weight. After operation, of course, they eat less owing to the restrictive pouch size, but the ones who eat the largest meals are the ones who lose the least weight.

GREENFIELD: When I began my study I was surprised at how few psychological or surgical contraindications to these operations or predictors of success were documented. The advantage of setting up criteria to create groups of varying levels of success, however arbitrary, is that it allows point of view comparison and good statistical analyses as well as clinical analyses of patients who undergo the same operation.

FLICKINGER: (Ed Flickinger, Greenville, North Carolina.) Is there a correlation between weight criteria and amelioration of medical complications and symptoms?

BROLIN: We found an absolute correlation in that regard. Everybody that lost weight, particularly during the period of active weight loss, experienced substantial improvement with associated medical problems. Even some who lost a relatively modest amount of weight did benefit tremendously in terms of amelioration of medical problems. On the other
hand, some patients who have begun to regain are having recurrence of those associated medical problems.

LECHNER: (George Lechner, Dayton, Ohio.) I think we should have uniform standards for determining ideal weight.

KRAL: I heartily agree with the idea that we should get together and use the same standards. In the past most surgeons have gone by the medium frame range of the Metropolitan Life Insurance Company tables. I feel this is a great injustice not only to the field of obesity surgery but to the patients who are extremely obese. Patients who have, with time, acquired a much greater body cell mass than would correspond to people who never have been obese should not be measured by the same standards. I think we must have different standards such as complications of the obesity. We should try to develop statistics and criteria that show what in fact we are doing to relieve not only the medical complications but also to improve the quality of life.

COMMENT: Unfortunately, despite all our evaluations, the bottom line is what the insurance companies are willing to pay for.

SPENCE: Most insurance companies are requiring at least 200% of ideal weight according to their tables and other medical conditions that are aggravated by weight.

KRAL: This problem, of course, is extremely complex. There are 50 states and there are at least as many major insurance carriers who all might develop their own criteria. Consequently, it's very difficult to come up with any rule of thumb.

DRENNICK: It seems to me that this Society and perhaps other societies who are primarily interested in weight control should take a leading hand in persuading insurance companies to accept something that seems reasonable to us. I'm in agreement with Dr. Kral that the usual tables we have been using are too rigorous, the ideal weights are too low for the average superobese individuals. I believe we should recommend the authoritative table established by the Haynes Survey to the third party carriers and to everybody else. Weights in that table are considerably higher than the so-called ideal or minimum weights for medium frame and I would make a plea for it.
LONG-TERM EFFECTS OF GASTRIC BYPASS: THE GOOD AND BAD NEWS
Leonard V. Crowley, M.D., James Seay, M.D., and Gerald Mullin, M.D.

Massive obesity is a major health hazard. Since treatment by diet is frequently unsuccessful, many surgical procedures have been devised to achieve weight loss either by limiting food intake or preventing its absorption. The gastric bypass procedure achieves weight loss primarily by restricting food intake, but also produces other physiologic derangements which are similar to those which follow an extensive Billroth II subtotal gastrectomy. Not only is the reservoir function of the stomach impaired, but its digestive and secretory functions are compromised as well. Release of iron, calcium, and vitamin $B_{12}$ from food by gastric digestion is much less efficient, and the food is discharged directly into the jejunum, bypassing about 40 cm of duodenum and proximal jejunum which are major sites of iron and calcium absorption.

The long-term adverse effects of subtotal gastrectomy are well known. Subtotal gastrectomy patients often develop protein, vitamin, and mineral deficiencies, and many become anemic due to single or multiple deficiencies of iron, folic acid, and vitamin $B_{12}$. Osteoporosis may result from inadequate intake and impaired absorption of calcium, and some patients also develop osteomalacia due to coexisting vitamin D deficiency. Many of these postgastrectomy complications only become apparent when patients have been followed up for many years.

One might expect similar late complications in gastric bypass patients, and indeed some have already been reported.

In order to obtain more information on the long-term favorable and unfavorable results of the gastric bypass for obesity, we contacted 110 patients who had a gastric bypass performed between 1974 and 1979 and invited them to participate in a clinical, dietary, and laboratory evaluation. Thirty-nine women and two men agreed to participate, which was 37% of the patients contacted. Their mean age at the time of the bypass was 37 years, and average time from bypass to evaluation was seven years. It is possible that this group may not be representative of all long-term bypass patients because the patients who entered the study may have differed in some way from those who did not. As far as we could determine, however, the patients we studied were representative of the entire group of patients.
Results

The overall response of the participants to the bypass was favorable. Most reported greater satisfaction with life after losing weight. Thirty-one patients indicated that if they had to make the decision again, they would have the bypass performed. Four patients indicated they would not, and six were undecided. Prebypass weight ranged from 78 to 168 kg (172-330 lbs). When weight loss was expressed as a percentage of prebypass weight, nine patients lost over 40% of prebypass weight; 23 lost from 30 to 40%; seven lost from 20 to 30%, and two lost less than 20% of their prebypass weight. Average weight loss for the group was 39 kg (86 lbs), which was 34% of prebypass weight.

Many patients were consuming inadequate diets, as determined by dietary analyses. The most clinically significant deficiencies were in calcium intake, which was inadequate in 75% of patients, together with iron and vitamin D intake, which were deficient in 90% of these patients. The deficiencies were quite marked in many subjects. Moreover, about 1/3 of the patients were not taking any type of vitamin or mineral supplements to help compensate for the deficiencies.

The major long-term adverse effects which we encountered were iron and B\textsubscript{12} deficiencies and postbypass musculoskeletal problems.

**IRON AND VITAMIN B\textsubscript{12} DEFICIENCIES**

Table 1 summarizes the iron and B\textsubscript{12} deficiencies that we encountered.

<table>
<thead>
<tr>
<th></th>
<th>Number of Subjects</th>
<th>Number with Anemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>B\textsubscript{12} Deficiency Only</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Combined B\textsubscript{12} - Iron Deficiency</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Iron Deficiency Only</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Low Iron Stores</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>36</td>
<td>10</td>
</tr>
</tbody>
</table>

Twenty-one subjects were B\textsubscript{12} deficient. Sixteen of the 21 had an isolated vitamin B\textsubscript{12} deficiency without coexisting iron deficiency, and five of them were anemic. The other five patients had a combined B\textsubscript{12} and
iron deficiency, and three of this group were also anemic. Nine patients were iron deficient without associated vitamin $B_{12}$ deficiency, and two of them were anemic. Six more patients, although not iron deficient, had reduced iron stores as determined by low serum ferritin levels. If we include these latter patients, 36 of 41 patients exhibited either reduced iron stores or various vitamin $B_{12}$ and iron deficiencies, and ten were anemic.

In addition to these current deficiencies, 13 patients had been previously treated for anemia that occurred one or more years after the bypass. Most were iron deficiency anemias, and over 80% responded to oral iron, but a few did not and required parenteral iron. Two of these patients had previously been treated for megaloblastic anemias due to vitamin $B_{12}$ deficiency.

Schilling test results were abnormal in 15 of the 21 $B_{12}$ deficient subjects. Their mean isotope excretion was 3%, which increased to almost 17% when the labeled vitamin was administered with intrinsic factor, indicating that the abnormal Schilling tests were due to lack of available intrinsic factor.

Seventeen vitamin $B_{12}$ deficient patients received a one-month course of 50 mcg oral vitamin $B_{12}$ tablets, in order to determine whether we could achieve sufficient additional vitamin $B_{12}$ absorption by nonintrinsic factor mediated mechanisms to restore serum vitamin $B_{12}$ to normal. Over half the patients failed to respond. These were the most severely deficient patients as demonstrated by mean serum $B_{12}$ of 81 pg/ml and they usually had abnormal Schilling tests. The less severely deficient patients, whose serum $B_{12}$ levels were higher and whose Schilling tests were more often normal, usually responded to oral tablets (Table 2).
TABLE 2
Correlation of Initial Serum Vitamin B₁₂ Concentration with Response to Oral B₁₂ Tablets and Schilling Test Results

<table>
<thead>
<tr>
<th>No. Subjects</th>
<th>Initial Serum B₁₂ - pg/ml</th>
<th>Repeat Serum B₁₂ - pg/ml</th>
<th>Urine Schilling Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>49-172</td>
<td>29-160</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Response</td>
<td>10</td>
<td>Mean 81</td>
<td>Mean 86</td>
</tr>
<tr>
<td></td>
<td>124-200</td>
<td>215-300</td>
<td>Normal</td>
</tr>
<tr>
<td>Response</td>
<td>7</td>
<td>Mean 150</td>
<td>Mean 250</td>
</tr>
</tbody>
</table>

Iron deficiency developing after bypass is the result of inadequate iron intake, inefficient liberation of iron from food due to inadequate gastric digestion, and bypass of the duodenum which is a major site of iron absorption. The pathogenesis of the vitamin B₁₂ deficiency after gastric bypass is complex and is probably not the same as postgastrectomy vitamin B₁₂ deficiency. In our patients, the vitamin B₁₂ deficiency occurred primarily because of poor absorption of vitamin B₁₂ which could have resulted either from insufficient secretion of intrinsic factor, from failure of vitamin B₁₂ and intrinsic factor to interact properly because of the conditions imposed by the bypass, or from a combination of both factors. Gastric acid secretion often falls after gastric bypass and intrinsic factor secretion by parietal cells probably also declines along with acid secretion, which would reduce the efficiency of vitamin B₁₂ absorption.

Inefficient vitamin B₁₂-intrinsic factor interaction related to the bypass is probably another and possibly more important cause of vitamin B₁₂ deficiency than is reduced secretion of intrinsic factor. In the normal intact stomach, much of the vitamin B₁₂ binds at the pH of gastric juice not with intrinsic factor, but with other vitamin B₁₂ binding proteins designated R protein, and the vitamin B₁₂ bound to R protein is
not available for absorption in the ileum. In the duodenum, however, the pancreatic enzymes degrade the R protein which liberates the vitamin $B_{12}$ to combine with the more stable intrinsic factor, and the vitamin $B_{12}$-intrinsic factor complex passes to the ileum where the vitamin is absorbed. In the bypass patient, any ingested vitamin $B_{12}$ is combined primarily with R protein which passes directly into the jejunum, short-circuiting the duodenal loop where the vitamin is normally freed from R protein and recombined with intrinsic factor. At the same time, the intrinsic factor in the gastric juice secreted by the stomach distal to the staple line must travel through the duodenum and proximal jejunum before eventually "catching up" with the $B_{12}$ bound to R protein in the jejunum. Interaction of vitamin $B_{12}$ with intrinsic factor is less efficient under these circumstances and there may not be enough uptake to supply the needs of the patient.

**BYPASS BONE DISEASE**

Table 3 summarizes the manifestation of the third major late complication of gastric bypass which we call "bypass bone disease."

<table>
<thead>
<tr>
<th>Manifestations of &quot;Bypass Bone Disease&quot;</th>
<th>Number of Subjects</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musculoskeletal Symptoms</td>
<td>26</td>
<td>63</td>
</tr>
<tr>
<td>Height Loss</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td>Laboratory Test Abnormalities</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

This condition results from negative calcium balance, leading to osteoporosis, and is sometimes associated with osteomalacia due to coexisting vitamin D deficiency. Its manifestations include 1) post-bypass musculoskeletal aches and pains which occurred in about 2/3 of the patients within the first five years after the bypass, 2) loss of height which occurred in about 1/3 of the patients; seven patients lost 1/2 inch and the other seven lost from one to two inches, which is highly significant, and 3) laboratory abnormalities which occurred in about 10% of the patients. Three patients had high serum alkaline phosphatase levels, and one had low serum calcium, findings which would be consistent with
osteomalacia. Two of these patients had been hospitalized previously for musculoskeletal problems.

**Long-Term Management of the Bypass Patient**

Based on our experience with this group of subjects we believe that all bypass patients require long-term follow-up in order to prevent late complications. In addition to dietary counseling, the bypass patients should be taking multivitamins, together with supplementary oral iron tablets, high dose oral vitamin B₁₂ tablets, and calcium supplements. Patients may require monthly B₁₂ injections if serum B₁₂ concentrations cannot be maintained by high dose oral tablets, and some patients may require parenteral iron if iron supplements are inadequately absorbed. It is difficult to achieve adequate calcium intake in bypass patients. In general, the hematopoietic complications of gastric bypass usually can be prevented and are relatively easy to treat if they occur. Bypass bone disease, however, may be a more difficult problem both to prevent and to treat.

**References**


CLOSED LOOP OBSTRUCTIVE SYNDROME: DIAGNOSIS, TREATMENT AND PREVENTION
George W. Lechner, M.D.

ABSTRACT
An unusual distal gastric and duodenal closed loop obstruction has occurred in about 1% of 830 gastric bypass patients. This is a serious life-threatening condition with unusual, but characteristic, clinical laboratory and radiographic findings, awareness of which allows one to achieve earlier diagnosis and treatment. A smaller number of related late bowel obstructions have occurred. These have been either internal hernias, mostly related to the 45-cm Roux-en-Y loops, or reverse intussusception into the large jejunojejunostomy anastomosis developed in attempt to eliminate the acute closed loop obstructions. Routine gastrostomy would not have avoided most of the cases. The prevention of these problems may reside in the construction of a very short 7-15-cm Roux-en-Y loop rather than the recommended 45-50-cm one. In over 260 cases done in this manner virtually no reflux has occurred and the only obstruction was from a clot blocking the jejunojejunostomy in a patient with a coagulation defect.

INTRODUCTION
Gastric bypass or subtotal gastric exclusion was the first gastric reduction procedure developed to control obesity. Many modifications of the technique have been made since the original procedure, the most significant in my opinion being (1) in situ stapling of the stomach rather than dividing it, (2) reduction in the original pouch size to a very small capacity, (3) Roux-en-Y retrocolic gastrojejunostomy, (4) calibration of the outlet with a single or double continuous nonabsorbable Lembert suture, (5) decreasing the size of this calibrated and fixed outlet to 8-9 mm³ and (6) perhaps the use of a double row of staples placed sufficiently far apart (1-2 cm) to create a scar barrier (Fig. 1) against possible breakthrough.
Many varieties of gastric partitioning as well as gastric banding, wrapping, balloon distention, pancreaticobiliary bypass, etc, have been done. The current preference seems to be for the vertically banded gastric partitioning. All have been developed as an alternative to gastric bypass to ostensibly decrease morbidity, mortality, operating time or interference with GI physiology, etc. Randomized prospective comparison\textsuperscript{3,7} between one of the better gastric partitioning operations and gastric bypass (later confirmed by Pories, et al\textsuperscript{8}) failed to show any significant difference between these two procedures, including safety, except in one area. That area is to me (and to the patient) the most significant one - i.e. the amount of, and the permanency\textsuperscript{7} of the weight loss. This is, after all, the bottom line in bariatric surgery. I believe that gastric bypass is still the "Gold Standard" since as yet no procedure has been shown to exceed or in the long term to even equal its results.
There are, however, occasional physiologic complications more or less unique to gastric bypass. These include Vitamin B-12, Folic Acid and occasionally other vitamin deficiencies and some cases of GI bleeding or iron deficiency anemias. Acutely or subacutely there is also a dramatic and dangerous closed loop obstruction of the distal stomach and duodenum. This is generally known to most experienced gastric bypass surgeons, but very little has been written about it. This condition has characteristic symptomatology, laboratory, ultrasonic and radiographic findings. In its acute phase it is highly dangerous and early diagnosis and treatment are essential. The purpose of this report is to delineate this syndrome, its diagnosis, treatment and hopefully its prevention.

I have found a few papers\textsuperscript{9,10,11} that indicate the existence and risks of the distal gastric obstructions, but the cases were either diagnosed late in the course of the illness and included with various unrelated perforations or described as acute gastric dilatations either resulting from loop gastrojejunostomy or relating the cause to failure to decompress the proximal stomach. I could not find any references to the distal anastomotic obstructions delineating the typical clinical picture. No preventative measures other than prolonged use of the nasogastric tube or routine gastrostomy were suggested. I don't believe either of these is the solution.

THE SYNDROME

The acute problem typically occurs in the early postoperative period, developing any time from the night of surgery through the first several postoperative days (Table 1).
TABLE 1

EARLY ACUTE GASTRODUODENAL OR ROUX-EN-Y OBSTRUCTIONS

<table>
<thead>
<tr>
<th>Initials</th>
<th>Type of Obstruction</th>
<th>No. days PO</th>
<th>Reoperated</th>
<th>PATHOLOGY</th>
<th>TREATMENT</th>
<th>COMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>*</td>
<td>12/25</td>
<td></td>
<td>Kink at jejunojejunostomy</td>
<td>Jejunojejunostomy</td>
<td>Major infection 39</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Perforated stomach</td>
<td>Duodenoojejunostomy</td>
<td>Facial dehiscence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4000 ml evacuated</td>
<td>Close perforation</td>
<td>Incisional hernia</td>
</tr>
<tr>
<td>BB</td>
<td>*</td>
<td>3</td>
<td></td>
<td>Kink at jejunojejunostomy</td>
<td>Jejunojejunostomy</td>
<td>NONE 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1600 ml Evacuated</td>
<td>Gastrostomy</td>
<td>Aspiration pneumomia 8/16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spontaneous decompensation</td>
<td>Confirmed by EGD</td>
<td>Rupt. staple lines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Rupt. prox. staple lines)</td>
<td>and UGI</td>
<td>Restapled 2 yr PO</td>
</tr>
<tr>
<td>OC</td>
<td>*</td>
<td>3/9</td>
<td></td>
<td>Volvulus of Roux-En-Y</td>
<td>Reduce volvulus</td>
<td>Necrosis-perforation 46</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Into paraduodenal hernia</td>
<td>Close defect</td>
<td>of Roux-En-Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300 ml evacuated</td>
<td>Later resected</td>
<td>Wound &amp; subphrenic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Roux-En-Y, Gastrostomy</td>
<td>Infections</td>
</tr>
<tr>
<td>SJ</td>
<td>*</td>
<td>2</td>
<td></td>
<td>Gangrene Roux-En-Y</td>
<td>Resect and replace</td>
<td>DEATH-probable 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hemorrhagic pancreatitis</td>
<td>Roux-En-Y</td>
<td>arrhythmia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Embolus mesenteric vein</td>
<td>Gastrostomy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(No mechanical obstruction)</td>
<td>4000 ml evacuated</td>
<td></td>
</tr>
<tr>
<td>KB</td>
<td>*</td>
<td>18</td>
<td></td>
<td>Obstruction at ligament of</td>
<td>Gastroduodenal</td>
<td>Had small staple 31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treitz - inflammatory mass</td>
<td>exploration</td>
<td>line dehiscence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3rd part duodenum</td>
<td>Gastrostomy</td>
<td></td>
</tr>
<tr>
<td>KB</td>
<td>*</td>
<td>7</td>
<td></td>
<td>Post JIB conversion</td>
<td>Resect and shorten</td>
<td>Major infection 27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distal bowel still small</td>
<td>Roux-En-Y hook-up</td>
<td>Rupt. staple lines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distended necrotic perf.</td>
<td>Roux-En-Y</td>
<td>Prolonged bilirubin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jejunojejunostomy</td>
<td>Gastrostomy</td>
<td>Restapled 1 1/2 yr PO</td>
</tr>
<tr>
<td>PG</td>
<td>#</td>
<td>2/18</td>
<td></td>
<td>Von Willebrand's Disease</td>
<td>Evacuate clots</td>
<td>Major infection 35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large clot obstructing the</td>
<td>Gastrostomy</td>
<td>Dehiscence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>jejunojejunostomy</td>
<td>Close dehiscence</td>
<td>Incisional hernia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2300 ml evacuated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = 45 cm Roux-En-Y, cephalad directed afferent limb from rt.
** = 45 cm Roux-En-Y, cephalad directed afferent limb from lt.
# = 10-15 cm Roux-En-Y, caudally directed afferent limb from lt.

The patient becomes acutely ill with several of the following complaints or findings (Table 4). He may have tachycardia, tachypnea, labored shallow respirations, weak pulse, oliguria and diaphoresis. Cyanosis may be present, and hypoxemia tends to be greater than expected. Abdominal fullness or excessive wound pain may be complained of, and occasionally supraclavicular pain develops. Although obesity masks the distention, a nearly invariable complaint is epigastric fullness frequently associated with severe back pain in the retrogastric area. This complaint should be elicited if not volunteered. Extreme anxiety tends to be present in most patients. Others are unusually sleepy. Hydrophilia has been present in two patients. The response to volume loading and plasma expanders tends to be poor. Retching and vomiting develop and worsen with time, and the amount of gastroesophageal mucous and fluid increases, despite reintubation with a nasogastric tube. The emesis or aspirate becomes
blood tinged and then frankly bloody. The urine develops a dark appearance.

**TABLE 4**

**SYMPTOMATOLOGY - ACUTE OBSTRUCTIONS**

<table>
<thead>
<tr>
<th>Back Pain</th>
<th>Excess Abd pain</th>
<th>Excess Anxiety</th>
<th>Unusual Lethargy</th>
<th>Excess Intake</th>
<th>Unusual Emesis</th>
<th>Abdominal Fullness</th>
<th>Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PM</td>
<td>4+</td>
<td>2+</td>
<td>4+</td>
<td>2+</td>
<td>4+</td>
<td>3+</td>
<td>3+</td>
</tr>
<tr>
<td>2 BB</td>
<td>4+</td>
<td>1+</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1+</td>
<td>2+</td>
</tr>
<tr>
<td>3 KV</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>0</td>
<td>3+</td>
<td>2+</td>
<td>0</td>
</tr>
<tr>
<td>4 OC</td>
<td>3+</td>
<td>2+</td>
<td>3+</td>
<td>0</td>
<td>2+</td>
<td>1+</td>
<td>3+</td>
</tr>
<tr>
<td>5 SJ</td>
<td>0</td>
<td>2+</td>
<td>1+</td>
<td>0</td>
<td>2+</td>
<td>4+</td>
<td>3+</td>
</tr>
<tr>
<td>6 KB</td>
<td>2+</td>
<td>1+</td>
<td>0</td>
<td>4+</td>
<td>3+</td>
<td>3+</td>
<td>0</td>
</tr>
<tr>
<td>7 HB</td>
<td>0</td>
<td>3+</td>
<td>2+</td>
<td>1+</td>
<td>0</td>
<td>3+</td>
<td>0</td>
</tr>
<tr>
<td>8 PG</td>
<td>4+</td>
<td>2+</td>
<td>2+</td>
<td>3+</td>
<td>0</td>
<td>3+</td>
<td>1+</td>
</tr>
</tbody>
</table>

+ = 45 cm Roux-en-Y, 10 cm jejunojejunostomy, cephalad directed limb from IT

Rapidly rising levels of bilirubin associated with elevations of serum and urinary amylase and serum lipase, as well as low calcium and rising alkaline phosphatase usually occur (Table 3).

**TABLE 3**

**LABORATORY DATA - ACUTE OBSTRUCTIONS**

<table>
<thead>
<tr>
<th>Normals</th>
<th>Adm &amp; High Bilirubin</th>
<th>Persistent Elevation</th>
<th>Highest Amylase</th>
<th>Highest Lipase</th>
<th>Adm &amp; Low Ca</th>
<th>Adm &amp; Low Albumen</th>
<th>Adm &amp; High AlkPhatase</th>
<th>Adm &amp; High CBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>0.2/5.3</td>
<td>NO</td>
<td>126</td>
<td>46</td>
<td>9.6/7.4</td>
<td>4.2/2.6</td>
<td>94/639</td>
<td>6.6/34.8</td>
</tr>
<tr>
<td>BB</td>
<td>0.6/2.4</td>
<td>NO</td>
<td>--</td>
<td>--</td>
<td>8.8/7.5</td>
<td>3.9/2.6</td>
<td>106/235</td>
<td>8.8/30.0</td>
</tr>
<tr>
<td>KW</td>
<td>0.3/4.9</td>
<td>NO</td>
<td>--</td>
<td>--</td>
<td>8.6/6.9</td>
<td>3.4/2.1</td>
<td>87/233</td>
<td>5.9/18.6</td>
</tr>
<tr>
<td>OC</td>
<td>1.1/8.1</td>
<td>YES</td>
<td>720</td>
<td>134</td>
<td>9.2/7.0</td>
<td>4.0/2.3</td>
<td>81/399</td>
<td>6.0/39.3</td>
</tr>
<tr>
<td>SJ</td>
<td>0.5/2.1</td>
<td>DIED</td>
<td>1759</td>
<td>244</td>
<td>8.6/7.5</td>
<td>4.4/3.2</td>
<td>67/---</td>
<td>6.4/18.9</td>
</tr>
<tr>
<td>KB</td>
<td>0.6/4.5</td>
<td>YES</td>
<td>121</td>
<td>18(N)</td>
<td>9.1/7.7</td>
<td>4.1/2.4</td>
<td>90/216</td>
<td>12.7/18.0</td>
</tr>
<tr>
<td>HB</td>
<td>0.6/5.7</td>
<td>YES</td>
<td>189</td>
<td>34</td>
<td>9.0/6.4</td>
<td>4.1/2.5</td>
<td>87/970</td>
<td>8.7/22.1</td>
</tr>
<tr>
<td>PG</td>
<td>0.6/8.0</td>
<td>YES</td>
<td>275</td>
<td>42</td>
<td>9.6/7.8</td>
<td>4.6/3.1</td>
<td>66/188</td>
<td>5.9/24.7</td>
</tr>
</tbody>
</table>
The condition tends to worsen despite all therapy until the patient either spontaneously ruptures his or her staple lines or is surgically decompressed. The risk of both mortality and morbidity rise rapidly and both become very high with delays in treatment, so early diagnosis and surgical decompression is critical.

Since there is usually no air in the distal stomach the plain abdominal films show a ground glass upper abdominal appearance. Ultrasound typically demonstrates one or more grossly dilated fluid filled structures (Fig. 2).
If air is present, the CT scan is better (Fig. 3).
UGI demonstrates a grossly dilated Roux-en-Y loop, usually with a beak-like distal obstruction similar to a volvulus (Fig. 4).
Late cases have become symptomatic months later. They have presented with either a recurring intermittent partial or a complete obstruction at the jejunojejunostomy site which symptomatically has varied in severity from mild to severe. The cases I have experienced were due to reverse intussusceptions, internal herniae and Roux-en-Y distention or a combination (Table 2).

<table>
<thead>
<tr>
<th>Initials</th>
<th>Type</th>
<th>No. months PO</th>
<th>Reoperated</th>
<th>PATHOLOGY</th>
<th>TREATMENT</th>
<th>COMPLICATIONS (days)</th>
<th>Hosp stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 PT</td>
<td>10-80</td>
<td>29</td>
<td></td>
<td>Reverse intussuception</td>
<td>Resect jejunojejunostomy and convert to #</td>
<td>NONE</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acute obstruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MB</td>
<td>5-81</td>
<td>26</td>
<td></td>
<td>Intermittent obstruction</td>
<td>Resect jejunojejunostomy and convert to #</td>
<td>NONE</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paraduodenal hernia</td>
<td>Close internal and incisional herniae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Incisional hernia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 LRH</td>
<td>8-81</td>
<td>23</td>
<td></td>
<td>Recurrent acute obstruction</td>
<td>Resect jejunojejunostomy and convert to #</td>
<td>Gastric and</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reverse intussuception</td>
<td>Vagotomy, Gastrostomy</td>
<td>Intestinal atony</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hemorrhagic gastritis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 DM</td>
<td>1-82</td>
<td>14</td>
<td></td>
<td>Acute obstruction with Intermittent obstruction</td>
<td>Resect jejunojejunostomy and convert to #</td>
<td>NONE</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paraduodenal hernia with Hx</td>
<td>Close hernia defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>distended Roux-En-Y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 AD</td>
<td>1-82</td>
<td>18</td>
<td></td>
<td>Intermittent obstruction</td>
<td>Resect jejunojejunostomy and convert to #</td>
<td>NONE</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intestinal hernia at root of</td>
<td>Cholecystectomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mesentery, Cholelithiasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 RM</td>
<td>5-83</td>
<td>11</td>
<td></td>
<td>Intermittent reverse Intermittent obstruction</td>
<td>Reverse Gastric Bypass with resection of Roux-En-Y &amp; jejunojejunostomy (pts. insistance)</td>
<td>GI Bleeding, pain intolerance (known addict)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>intussuception with Intermittent obstruction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

‡ = 45 cm Roux-En-Y, 10 cm jejunojejunostomy, cephalad directed limb from rt

+ = 45 cm Roux-En-Y, 10 cm jejunojejunostomy, cephalad directed limb from lt

* = 45 cm Roux-En-Y, cephalad directed afferent limb from rt
There is a third group of patients who should be mentioned in this context only because of the possibility of their confusion with patients in the above mentioned groups and the sometimes similar radiographic findings. These patients have bowel obstructions of conventional etiology such as adhesive bands, volvulus, etc, but do not develop symptoms of closed-loop distal gastroduodenal obstructions. They may however show a large lower gastric air fluid level due to swallowed air filling the distal stomach in retrograde fashion. (Fig. 5) One had such a distended stomach that a gastrostomy was done.
PATHOLOGIC PHYSIOLOGY AND PATHOLOGIC FINDINGS

The condition develops because of obstruction at or near the jejuno-jejunostomy. The initial problem in the acute cases most often is a result of an angulation of the bowel from a fluid filled loop which causes a kink at the jejunojejunostomy which is relatively immobile since its mesentery is attached to both the gastrojejunostomy high on the stomach and the jejunojejunostomy. The heavy long J shaped Roux-en-Y loop is the most common culprit. The kinking then obstructs the afferent limb of the jejunum at the jejunojejunostomy. This creates a closed loop obstruction of the duodenum and the short afferent jejunal loop and most of the stomach which is stapled shut at the top. The total fluid output of the liver, pancreas, duodenum and most of the stomach is thus trapped in this closed loop. The jejunojejunostomy may partially pass the fluid at first in some cases, but finally the obstruction and distended afferent loop or Roux-en-Y loop so impinge on the jejunojejunostomy as to create a "ball valve" effect. At this point the stomach and duodenum rapidly and enormously distend with the trapping of the several liters of fluid secreted daily by these organs. If not decompressed soon the stomach and/or the Roux-en-Y loop may become stretched to the point of ischemia and perforation. The secretory pressure of the liver and pancreas is soon reached inside the stomach and duodenum resulting in increasing levels of bilirubin, amylase and lipase in the serum (see Table 3). Reflux of acid and enzymes into the pancreatic and biliary ducts may have been the cause of one severe and one mild case of acute pancreatitis and several cases of prolonged hyperbilirubinemia following decompression. One of the latter cases had cholangiograms at a third operation several days following decompression. They demonstrated extremely narrow ducts similar to those seen in sclerosing cholangitis. Some cases decompressed early have prompt return of bilirubin and enzyme levels to normal. Two cases however had elevations for over six weeks. This suggests that chemical cholangitis, probably from gastric acid, is the cause of the persistent hyperbilirubinemia that occurs. One case obstructed because of a kink at an unusually high ligament of Treitz
(Fig 6) so the Roux-en-Y and jejunojejunostomy functioned normally. Treatment is shown in Figures 6 & 7.
One decompressed herself spontaneously by rupturing her gastric staple lines. (Fig. 8)

Figure 8
She almost drowned in her secretions and developed some aspiration pneumonitis. She slowly decompressed distally and was later reoperated for restapling and revision of the anastomosis. The patient with severe hemorrhage pancreatitis had a necrotic Roux-en-Y loop and
jejunojejunostomy with no obvious cause for the ischemia or obstruction (Fig. 9).
The obstruction was functional, due to the dead bowel. This patient died suddenly, probably of a cardiac dysrhythmia, about three hours after decompression and resection as shown in Figure 10.
At autopsy an embolus in the superior mesenteric vein was found (see Fig. 9) This was probably the cause of the ischemic Roux-en-Y loop. The patient used considerable alcohol and had a 6500-gm fatty liver. One acute patient who had a clotting disorder occluded her jejunostomy with a large firm clot obstructing both the afferent and Roux-en-Y loops (Figure 11). She responded to clot evacuation through two jejunostomies.

Figure 11

Other laboratory changes which may occur in the acute phase may be part of the clinical picture or may be extraneous. The dark urine is obviously due to bile excretion. The alkaline phosphatase levels probably reflect the obstruction also. Liver enzyme levels are usually elevated for a few days following gastric bypass surgery, but they tend to recrudesce with obstruction and remain high. Serum calcium levels frequently drop following routine surgery but in obstructed cases have
been lower (6.9-7.8 mg/100 ml). This could be in part due to the lower protein levels seen (Table 3).

The late obstructions may be either intermittent or non-remitting. They are caused primarily by one of two things: (1) Three have been reverse intussusceptions into the jejunojejunostomy (Figure 12).

Figure 12
Reconstruction is shown in Figures 12 & 13.

Figure 13
One was intermittent and recurring, but would totally obstruct periodically. This patient had experienced so much trouble that even after obstruction was finally demonstrated on ultrasound, and surgery planned, he insisted on reversal of his gastric bypass. The other two were incarcerated, and totally obstructed at both the afferent and
Roux-en-Y loops. All three intussusceptions occurred in cases where I had constructed a very large (10 cm) jejunojunostomy opening (Fig. 14).
Figures 15 and 16 show a retroduodenal and retroanastomotic internal hernia developing behind the left-sided, cephalad-directed afferent limb apparently through a defect alongside the ligament of Treitz.

Figure 15
Treatment and reconstruction is shown in Figures 16 and 17.

Figure 16

Some of these potential defects had been closed, so presumably the pressure from the intermittently distended Roux-en-Y loop was a factor.
All of these late obstructions were treated by resection of the jejunojejunostomy and shortening of the Roux-en-Y loops, a technique to be described later and shown in Figure 19.

DISCUSSION AND EVALUATION OF SURGICAL TECHNIQUE

Basic Technique
A total of approximately 830 gastric bypasses have been done at the time of presentation of this article. All but two have been done utilizing a Roux-en-Y retrocolic gastrojejunostomy. One patient had a retrocolic loop and developed severe bile reflux, and another had an antecolic Roux-en-Y hookup. In almost all cases the mesentery was only divided minimally after dividing the upper jejunum with an Autosuture GIA stapling device. I feel the risks of loop ischemia and larger mesenteric defects as well as increased time do not justify the routine development
of a pedicled Roux-en-Y loop. Since the spring of 1979, all cases have had a very small (15-30 ml) pouch size and a gastrojejunostomy outlet calibration suture which I developed at that time. Earlier cases had a larger pouch (45-100 ml) and no calibration suture. Except for reducing the outlet calibration size from 34F to 26F, there has been little change in technique in the ensuing years except with regard to the Roux-en-Y and jejunojejunostomy hookup described below.

Most of the early gastrojejunostomy hookups involved an anastomosis similar to that shown in Figure 18. The afferent limb was directed cephalad with a short blind loop to accommodate a stapled 5-cm anastomosis, usually about 7-15 cm from the ligament of Treitz. Most afferent limbs were brought in from the right side since this was usually easier.
After experiencing a few acute obstructions I thought the problem could be alleviated by enlarging the jejunojejunostomy and thereby lowering the emptying point of the afferent limb (Fig. 14). This seemed to work for over 200 cases, but then another obstruction occurred and the patient died with mesenteric vein embolism (Fig. 9). The cause of this obstruction and the next one (high ligament of Treitz - Fig. 6) were unrelated to this large anastomosis, however. Not until one to three years after the original surgery did the liability of these large anastomoses become evident - that of reverse intussusception (Fig. 12). It has been suggested that a left-sided hookup would alleviate the problem, but later one of these with a cephalad-directed afferent limb also became obstructed. It was also obvious to me that routine gastrostomy as suggested by others would not have eliminated the problem in most cases, even if one could justify its risks in over 99% of patients who didn't need it for the less than 1% who might benefit. Gastrostomy probably would have benefited only four of the acute cases at most.

Because of the opinion that we are all taught that one must use at least a 45-cm Roux-en-Y limb in order to prevent reflux, it was very difficult for me to come to the conclusion that it was necessary to shorten this loop in order to eliminate the problems that the dilated and elongated loop caused. I was also doubtful that I could routinely direct the afferent limb caudally toward the jejunojejunostomy. The final, I hope, solution ultimately required overcoming both of these prejudices.

CURRENT TECHNIQUE

First in obstructed cases with necrosis or perforation requiring resection, then in other obstructions and finally in all cases done since December 1982, I have utilized the technique shown in Figure 19. This involves four things: (1) An extremely short Roux-en-Y loop with about 7-15 cm between the gastrojejunostomy and the jejunojejunostomy. The gastrojejunostomy is constructed first and then after calibration of its outlet, brought down and sutured to the root of the transverse mesocolon just in front of the pancreas. (2) The ligament of Treitz is routinely taken down if present, passing the Roux-en-Y through or near this area. (3) The jejunum is divided about 10-12 cm beyond the ligament of Treitz, then this afferent limb is laid along the left side of the Roux-en-Y limb.
and directed caudally. A side to side 5-cm stapled anastomosis is then made along the antimesenteric surface. I usually oversew it internally and externally. A sutured anastomosis could of course be utilized alternatively. (4) Finally the space between the two loops of bowel and the potential defects both to the right and left sides (Fig. 20) are then closed with sutures (Fig. 21).
RESULTS

Amazingly in the last 17 months and approximately 260 cases, virtually no one has admitted to any bile reflux even under close questioning. Almost as surprising is that I was able to direct all afferent limbs caudally, although this was admittedly difficult in a few patients. Only one patient has developed an acute closed loop obstruction and this was the result of a clot obstructing the lumen (Fig. 8) in a patient with a major coagulation defect related to Von Willebrands Disease. At operation she had no kinks and treatment consisted of evacuation of the hematoma.
Since gastric bypass has been demonstrated repeatedly to be more effective in achieving and maintaining long-term weight loss than other procedures, and since its morbidity and mortality are now also about the same as gastric partitioning with large series reporting 1% or less mortality, I believe GBP should have the cloud of concern about its earlier reported operative risks removed. I have done only one splenectomy and there have been no staple line, anastomotic, or pouch leaks in the last 600+ cases, and in earlier cases a higher leak rate with gastric partitioning was noted! The mortality rate has been less than 0.5% even though many patients are over 50 years of age and afflicted with many resultant serious medical problems.

In order to really compare results, we must also agree on some standards with regard to definition of ideal weight and what constitutes a good or excellent result. I have suggested that to be an excellent result, the patient should reach a non-obese state, defined as being less than 20% over ideal weight, which I have defined by the middle of the medium frame weight range on the 1959 Metropolitan Life Insurance table, or more easily as 100 lbs for five feet in height + 5 lbs per inch barefoot. Since over 50% of patients have been able to achieve excellent result status this may not be too strict a criterion.

I believe careful follow-up study and analysis of results with any bariatric procedure, old or new, is imperative. The best way to achieve high acceptance of these life-saving procedures by patients, physicians, and insurance companies, in my opinion, is to have a low morbidity and mortality coupled with a high sustained success rate and a low revision rate. Doing a "simpler, faster, safer, more anatomic or physiologic" procedure first, which must then be reoperated in order to achieve a better chance of success, is poor economy by any standard.

SUMMARY

A known but poorly delineated distal closed loop obstruction following gastric bypass, with its pathologic physiology, treatment and prevention is described. Its typical signs and symptoms are presented as well as a method of avoidance. It is hoped that prevention of this unusual complication of gastric bypass will remove the last stumbling
block to adopting gastric bypass as the current "Gold Standard" against which to measure other bariatric procedures.

BIBLIOGRAPHY

REOPERATION FOR POOR WEIGHT LOSS
Joseph A. Buckwalter, M.D., Charles A. Herbst, Jr., M.D., and Roger K. Khouri, M.D.

It has been established that good weight loss after an operation for morbid obesity is sometimes followed by weight gain. Neither the indications for reoperating upon patients who lose and then gain weight after a bariatric operation nor which operation should be performed have been established. Our experience with 31 patients who have been reoperated upon has been reviewed in an effort to answer these two questions. These are about 5% of patients upon whom we have performed bariatric operations.

At the time of first operation the patients had a mean age of 34.0 years and a mean excess weight of 118%. The lowest mean excess weight achieved was 62% at a mean of 15 months after operation. Reoperation was performed at a mean of 26.6 months after the first operation. By then the patients had gained to a mean excess weight of 86%. The reoperations were jejunileal bypass, loop gastric bypass, Roux-en-Y gastric bypass, gastrogastrostomy and technical revisions of the first operation. Twenty-seven patients have been followed up at least nine months; the mean follow-up period was 26 months. Nine patients lost to within 25% of ideal weight, nine to 25-50% of ideal weight, three patients had poor weight loss and six gained weight. Nine patients (29%) developed postoperative complications: wound infections, bleeding gastric ulcer, anastomotic leak and anastomotic obstruction.

We conclude: 1. Roux-en-Y gastric bypass is the most effective "second" bariatric operation. 2. It should only be done in the highly motivated and compliant patient who has been fully informed concerning the greater risk of a second operation and the possibility of a second failure to achieve good weight loss.
EVOLUTION OF GASTRIC BYPASS IN PRIVATE PRACTICE
Sheldon M. Solocheck, M.D.

Our gastric bypass series started in January 1976, and just as there has been an evolution in the original procedure nationally, so has there been in my practice.

The series reported on consists of 1000 patients operated on from January 1976 to May 1984. The original procedure performed was the original bypass described by Dr. Mason in 1967. Three of these transection procedures were performed from January 1976 to October 1976.

Starting in June 1977, the Alden-type bypass with a stapled pouch, 60-90-ml volume and 1-cm stoma with loop gastroenterostomy was performed until late 1979 and early 1980 when 29 Gomez gastroplasties were performed and finally abandoned by May 1980. The reasons for abandonment were too much post surgical emesis secondary to stomal stenosis and poor weight loss secondary to stomal dilatation; all but two have now been converted to bypass.

Another change which was adopted in early 1979 was to apply two superimposed staple lines to try and improve on an unsatisfactory staple-line disruption rate of 20%. Since that change, only three (0.35%) documented staple-line disruptions have occurred.

From 1980 to June 1982, the only change in the procedure has been reduction of the pouch to 30-40 ml. Starting in June 1982, all patients had a 75-cm Roux-en-Y, instead of a loop gastroenterostomy. These patients comprise Group IV. This was done for two reasons. For one, there were about 12 people with postoperative distention of the distal stomach who responded to placement of a distal gastrostomy. No apparent cause for this was found, but it was noted that no patients with Roux-en-Y developed this complication. Secondly, a few patients, about 2%, were developing bile reflux gastritis which was alleviated by the long Roux-en-Y limb. Also patients with preoperative symptoms of esophagitis were cured by performing a Roux-en-Y.

No change occurred in the procedure until June 1983. At that time we undertook a radical change. First, no longer were any gastric vessels ligated, instead, the pouch was fashioned by placing the TA90 stapler across the mobilized esophagogastric junction, and then by bringing the anterior wall of the stomach through the jaws of the stapler until a
30-ml pouch was fashioned. Finally two rows of staples were superimposed. Secondly, the anastomosis was made with the 21-mm EEA and thirdly, the stoma was reinforced with 8F radiopaque silastic tubing which was threaded on a 2-0 prolene suture and tied around the stoma. This procedure takes less than 60 minutes to perform and has many obvious advantages. For one, the pouch is anterior and is easier to work on. Secondly, there is little risk of gastric ischemia or injury to the spleen and thirdly, if the anastomosis or pouch look problematic, it is easy to cover the area with redundant stomach from each side of the pouch.

Group V is composed of patients who have had this new procedure. There are only six months of results for Group V, but the six-month percent of excess weight lost has increased steadily with each change in procedure. In Group I, 46.8% excess weight was lost in six months, which increased to 54% in Group III and IV and 57.5% in Group V.

One-year weight loss has improved from 59.7% in Group I to 68-69% in Groups III and IV. There is a slight steady improvement at all yearly increments as the procedure has been refined.

Early perioperative mortality was 0.5% for Groups I and II and 0% for Groups III, IV and V. Late related mortality was 0.25% for Groups I and II and was 0.48% for Groups III, IV and V. Two deaths were related to pulmonary emboli, three and one-half weeks and six months after operation and one 21-year-old woman died suddenly three months postoperatively.

Early perioperative complication rates requiring emergency operation were 3.5% in Groups I, II and III, but 1.9% were due to distal stomach distention which has now been totally alleviated in the Roux-en-Y groups. The percent emergency reoperation rate for Group IV is 5% and in Group V is 2.7%. If one disregards the 1.9% reoperation rate for distal gastric distention in Groups I through III, then the emergency reoperation rates for Groups I through III is 1.6%. It should be pointed out that since the stomas in Group V have been reinforced with 3-0 silk Lemberts, the emergency reoperation rate is only 1.6% in 180 cases. There were two perforations of the pouch and one subphrenic abscess without a demonstrated leak.
It was the high revision rate, mainly due to stomal enlargement, that has led to the use of silastic tubing to reinforce the stoma starting June 1983. In Group I, the revision rate is 41% but this includes 20% staple-line disruption which has now been almost completely alleviated since the utilization of double superimposed stapling. The revision rate without restapling is approximately 30%.

The revision rate for Group II is 19.4% and as time passes I'm sure all revision rates will increase. Hopefully, the rate for Group V will be low, perhaps less than 10%, but we'll have to wait at least three to four years to really know. There have been 11 (6.0%) ring erosions in Group V. One was found at autopsy in the patient who died six months after operation from massive pulmonary emboli; four were found during endoscopy on patients with large marginal ulcers; and one was found in a patient with chronic stenosis who underwent frequent dilation. The other five were found during endoscopy on patients admitted with frequent emesis. Most patients with ring erosion were chronic overeaters and many had psychological problems. In three patients, the rings passed without difficulty, the other seven still have theirs and are basically asymptomatic. Because of the erosion problem, flat oval silastic tubing has been used since May 7, 1984. Two widths are available, 7 mm and 10 mm, but so far only the 7-mm tubing has been used. Hopefully, pressure on the bowel will be distributed over a wider area, thereby decreasing the incidence of erosion.

I should also mention that I did try Marlex mesh in 14 patients undergoing stomal revision, and the results were disastrous. Almost all have had problems with stenosis, 12 requiring repeated dilatation, and seven of those requiring removal of the mesh.

I don't know the problems that others have had with mesh, though I suspect it is substantial, but the problem seems to arise because the wall of the bowel grows into the mesh, setting up inflammation and scarring. In the majority of cases, silastic tubing does not cause inflammation and is easily removed if necessary. More of our patients with externally reinforced stomas have stenosis, but I feel that the reasons for this are obvious since the stomas by virtue of their reinforcement will not dilate on their own.
Of course, as in physics, every action has an opposite reaction and if one paraphrases this concept into the field of bariatric surgery, we would expect some kind of negative result to every supposedly positive change that we make in our particular bypass procedure.

The best partitioning procedure will never be perfect, but will be a procedure where the positives far outweigh the negatives, and I feel that the anterior placed pouch with a silastic-reinforced stoma is currently one of those procedures. It is simple, safe and can be used for bypass or gastroplasty. I, myself, favor bypass because I feel that weight loss is faster and more enduring in a greater percentage of patients, and it has an equally acceptable complication rate. I realize that there is an advantage to being able to visualize the distal stomach, but I feel that since safe maximum weight loss is the name of the game, then bypass is the better procedure as long as the stoma is reinforced.

Anterior gastric bypass with roux-en-y and silastic stoma reinforcement
**PATIENT STATISTICS**

<table>
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<tr>
<th>Measure</th>
<th>Value</th>
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<tr>
<td>Average Age</td>
<td>34.4 (Range 14-63)</td>
</tr>
<tr>
<td>Average Weight</td>
<td>267.5 ± 47.8 LBS</td>
</tr>
<tr>
<td>Average Per Cent of Ideal Weight</td>
<td>218.4 ± 34%</td>
</tr>
<tr>
<td>Average Pounds Over Weight</td>
<td>144.6 ± 41 LBS</td>
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---

**PATIENT GROUPS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Time Period</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>JANUARY 1, 1976 THRU DECEMBER 31, 1979</td>
</tr>
<tr>
<td>II</td>
<td>JANUARY 1, 1979 THRU MAY 30, 1981</td>
</tr>
<tr>
<td>III</td>
<td>JUNE 1, 1981 THRU JUNE 15, 1982</td>
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<tr>
<td>IV</td>
<td>JUNE 16, 1982 THRU MAY 30, 1983</td>
</tr>
<tr>
<td>V</td>
<td>JUNE 1, 1983 THRU PRESENT</td>
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5-12-84
### PER CENT EXCESS WEIGHT LOST

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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<tbody>
<tr>
<td>6 MO</td>
<td>46.8 ± 13.2</td>
<td>49.9 ± 13.7</td>
<td>54.0 ± 12.8</td>
<td>54.0 ± 13.4</td>
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<td>(111)</td>
<td>(159)</td>
<td>(188)</td>
<td>(138)</td>
<td>(60)</td>
</tr>
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<td>1 YR</td>
<td>59.7 ± 16.4</td>
<td>65.0 ± 17.9</td>
<td>68.8 ± 15.6</td>
<td>68.8 ± 16.5</td>
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<tr>
<td></td>
<td>(100)</td>
<td>(147)</td>
<td>(199)</td>
<td>(106)</td>
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</tr>
<tr>
<td>1½ YR</td>
<td>62.0 ± 19.2</td>
<td>67.2 ± 16.9</td>
<td>74.0 ± 16.2</td>
<td>71.5 ± 17.2</td>
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<tr>
<td></td>
<td>(61)</td>
<td>(113)</td>
<td>(134)</td>
<td>(26)</td>
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<tr>
<td>2 YR</td>
<td>62.9 ± 20.8</td>
<td>65.5 ± 21</td>
<td>68.8 ± 18.9</td>
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<td></td>
<td>(54)</td>
<td>(170)</td>
<td>(128)</td>
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<tr>
<td>3 YR</td>
<td>58.6 ± 22.1</td>
<td>62.1 ± 22</td>
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<td>---</td>
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</tr>
<tr>
<td></td>
<td>(68)</td>
<td>(132)</td>
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<tr>
<td>4 YR</td>
<td>59.5 ± 20.9</td>
<td>59.8 ± 22.8</td>
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<td>5 YR</td>
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<td>(36)</td>
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</tr>
<tr>
<td>6 YR</td>
<td>54.1 ± 15.7</td>
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<td>(8)</td>
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5-12-84
GASTRIC BYPASS REVISION RATES

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>I (141)</th>
<th>II (247)</th>
<th>III (258)</th>
<th>IV (176)</th>
<th>V (180)</th>
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<tbody>
<tr>
<td>TOTAL</td>
<td>41% (58)</td>
<td>19.4% (48)</td>
<td>10.8% (28)</td>
<td>7.4% (13)</td>
<td>9.4% (17)</td>
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<tr>
<td>DECREASE STOMA</td>
<td>31% (44)</td>
<td>14.1% (35)</td>
<td>2.3% (6)</td>
<td>1.2% (2)</td>
<td>0.6% (1)</td>
</tr>
<tr>
<td>DECREASE POUCH</td>
<td>23% (32)</td>
<td>13.4% (33)</td>
<td>1.9% (5)</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>CONVERT TO ROUX-EN-Y</td>
<td>21% (30)</td>
<td>12.6% (31)</td>
<td>3.5% (9)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>SURGICAL DILATATION</td>
<td>1% (2)</td>
<td>1.2% (3)</td>
<td>0.4% (1)</td>
<td>0.0%</td>
<td>2.7% (5)</td>
</tr>
<tr>
<td>ENDOSCOPIC DILATATION</td>
<td>0%</td>
<td>1.6% (4)</td>
<td>6.6% (17)</td>
<td>5.7% (10)</td>
<td>8.8% (16)</td>
</tr>
<tr>
<td>RESTAPLE POUCH</td>
<td>19.9% (28)</td>
<td>3.2% (8)</td>
<td>0.4% (1)</td>
<td>0.6% (1)</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

5-12-84
CONVERSION OF GASTROPLASTY TO ROUX-EN-Y GASTRIC BYPASS
Jose C. Torres, M.D., Clemente F. Oca, M.D., Hubert M. Honer

ABSTRACT
From January 1982 to April 1984, 20 patients with lesser curvature gastroplasty had conversion to Roux-en-Y gastric bypass at the lesser curvature for failure to lose more than 50% of excess body weight within 12 months of the original gastroplasty.

The average excess weight of these patients before gastroplasty was 103 lbs, and the average excess weight before conversion to gastric bypass was 73 lbs. The average weight loss after gastric bypass was doubled within six to 15 months. Only one patient failed to lose weight after conversion to gastric bypass, and this patient had endocrine problems.

Late surgical complications occurred in two patients (10%); one had cholecystectomy and the other had vagotomy and hiatal hernia repair. There were no deaths in this series.

INTRODUCTION
Gastric surgery for control of morbid obesity has been well documented over the last 15 years. The success of weight loss with minimum side effects and minimum complications depends on the type of gastric reduction procedure performed. In general, gastric bypass Roux-en-Y (lesser and greater curvature) and several types of gastroplasty are the most widely used procedures. Gastric wrap, gastro-gastric anastomosis, vertical stapling and biliopancreatic bypasses also have been described. The gastric partitioning previously described has become unpopular.

Over the last five years, we have performed over 900 lesser curvature Roux-en-Y gastric bypasses and 100 gastroplasties with gastrogastric anastomosis at the lesser curvature. Thirty-one of 100 patients who underwent gastroplasty did not lose more than 50% of their excess body weight, and from this group, 20 patients later underwent conversion of the gastroplasty to Roux-en-Y gastric bypass at the lesser curvature.

PATIENTS AND METHODS
From January 1982 to April 1984, 20 patients who had previously undergone lesser curvature gastroplasty were converted to Roux-en-Y
gastric bypass at the lesser curvature for failure to lose more than 50% of their excess weight within 12 months. There were 19 women and one man. The average age at the time of the original gastroplasty was 39 years, and 40.5 years at the time of gastric bypass. The average weight on admission for the initial gastroplasty was 234 lbs with 103 lbs of excess weight (79%). Before the conversion to gastric bypass, the average weight on admission was 204 lbs with 73 lbs of excess weight (56%). The average ideal weight for both groups of patients was 131 lbs, with the average height being five feet, four inches.

Each of these patients admitted for conversion procedures had undergone endoscopy and were found to have a gastric pouch that was normal in size, although some of the stomas had been enlarged to more than 12 mm in diameter. Eleven patients had concomitant diseases and conditions: gallbladder disease (4), diabetes (2), gastrogastric fistula (1), gastritis (5) (severe reflux esophagitis in one), hiatal hernia (4), hypertension (2) and ventral hernia (3).

**OPERATIVE TECHNIQUE**

The abdominal cavity is entered through an upper midline incision from the xiphoid process to the umbilicus. Gomez retractors are placed in position after intra-abdominal examination. Dissection is carried to the upper abdomen, releasing any adhesions from previous surgery. A previously placed nasogastric tube facilitates isolation of the distal esophagus and passage of a Penrose drain. The left lobe of the liver is retracted superiorly, and the area of the gastric hepatic ligament and the lesser curvature of the stomach is dissected and exposed. The previous partition is dissected anteriorly and posteriorly toward the angle of His.

The TA55 stapling instrument is inserted from the angle of His toward the lesser curvature of the stomach. One or two rows of staples are used to close the gastrogastric communication from the previous gastroplasty. Reinforcement sutures are placed along the staple line using 4-0 nonabsorbable suture.

The partition forms an upper and lower pouch excluding more than 97% of the stomach. The upper pouch is opened in the middle of a purse-string suture placed at the lesser curvature to permit introduction of the anvil portion of the EEA21 stapling device for the gastrojejunostomy.
The jejunum is divided 20 inches from the ligament of Treitz between two instrumental purse-string devices. The proximal end of the jejunum is anastomosed to the distal jejunum 40 inches from the divided area. An end-to-side anastomosis is used through a proximal transverse jejunostomy to establish intestinal continuity. An EEA25-mm staple cartridge is used for this jejunoojejunostomy. The transverse jejunostomy is closed with a TA30 cartridge. The distal segment of the divided jejunum is passed through a retrocolic window and anastomosed to the upper pouch of the stomach at the lesser curvature, using an EEA21-mm staple cartridge inserted through a transverse jejunostomy in the Roux limb.

After the gastrojejunostomy is completed and the instrument removed, the stoma is imbricated using 4-0 nonabsorbable figure-of-eight or double figure-of-eight interrupted sutures to diminish the size of the stoma to about 10 mm in diameter. A 28F catheter is used as a stent by passing it through the jejunostomy toward the gastric pouch. The jejunostomy is closed using a TA30 staple cartridge (Figure 1).

Figure 1  Jejunum is divided 20 inches from ligament of Treitz between A (proximal) and B (distal). TA-55 stapler is applied from angle of His to lesser curvature bypassing 97% of stomach and forming 25 to 35 ml upper pouch. Distal jejunum (B) is anastomosed to upper pouch at lesser curvature using EEA-21 stapler. Proximal jejunum (A) is anastomosed to distal jejunum approximately 40 inches from stomach using 25-mm staple cartridges.
The nasogastric tube is placed above the stoma. The mesenteric defects are approximated, and after irrigation, the abdomen is closed with large nonabsorbable suture.

Broad spectrum antibiotics are given preoperatively and continued for 24 to 48 hours. Aspirin is given two days before surgery. Occasionally, heparin is given postoperatively. The nasogastric tube is removed six to eight hours after operation, if there is no drainage of blood. If progress is satisfactory, a clear liquid diet is started on the third postoperative day and continued for two weeks. In the third week, the patient is allowed pureed food with a caloric intake of 700 to 1000 calories per day. By the fifth week, foods of ordinary consistency are allowed but intake is not to exceed 700 to 1000 calories per day.

The patient is usually discharged on the fourth or fifth postoperative day and is then seen in the office at regular intervals. The patient's weight is checked every three months until it stabilizes.

RESULTS

Of the 20 patients converted from gastroplasty to gastric bypass, nine had conversion alone and 11 had 18 concomitant operations: cholecystectomy (5), closure of gastrogastric fistula (1), hiatal hernia repair (4), ventral herniorrhaphy (3), and vagotomy (5).

Two late complications occurred (10%); one in a patient who underwent cholecystectomy for cholelithiasis and the other in a patient who had vagotomy, ventral and hiatal hernia repair. One patient failed to lose weight owing to other associated problems. There were no deaths in our series.
Weight loss is shown in Table 1. After gastric bypass, 19 patients had an average weight loss of 57 lbs by 12 months compared to 43 lbs by 12 months after initial gastroplasty.

TABLE 1 - Comparison of Weight Loss in 29 Patients with Gastropasty Conversion to Roux-en-Y Gastric Bypass

<table>
<thead>
<tr>
<th>Time of Follow-up</th>
<th>After Gastropasty Pounds</th>
<th>(%)</th>
<th>After Roux-en-Y Pounds</th>
<th>(%)</th>
<th>Total Weight Loss Pounds</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months</td>
<td>33</td>
<td>(25)</td>
<td>35</td>
<td>(27)</td>
<td>68</td>
<td>(52)</td>
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<tr>
<td>6 months</td>
<td>42</td>
<td>(32)</td>
<td>42</td>
<td>(32)</td>
<td>84</td>
<td>(64)</td>
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<tr>
<td>9 months</td>
<td>50</td>
<td>(38)</td>
<td>50</td>
<td>(38)</td>
<td>100</td>
<td>(76)</td>
</tr>
<tr>
<td>12 months</td>
<td>43</td>
<td>(33)</td>
<td>57</td>
<td>(44)</td>
<td>100</td>
<td>(76)</td>
</tr>
<tr>
<td>15 months</td>
<td>49</td>
<td>(37)</td>
<td>55</td>
<td>(42)</td>
<td>104</td>
<td>(79)</td>
</tr>
</tbody>
</table>

DISCUSSION

Failure to lose weight after gastric reduction is a disappointing experience for both the patient and the surgeon. Inadequate weight loss after gastroplasty occurs in many patients. Gastric bypass Roux-en-Y procedures have been thought to be technically difficult and demanding. However, dissatisfaction with weight loss after gastroplasty is evident, and the Roux-en-Y gastric bypass has proved to result in better weight loss over the long term.

The incidence of leakage and splenectomy reported in other series are minimal with gastric bypass with gastrojejunostomy at the lesser curvature. The use of the TA55 to partition the stomach from the angle of His to the lesser curvature allows creation of a small pouch, which measures from 25 to 35 ml in capacity. By using the EEA stapling cartridge for the gastrojejunostomy and jejunojejunostomy, construction of a reliable anastomosis with minimal operative manipulation is accomplished which also allows early function. By reducing the size of the stoma to approximately 10 mm in diameter, there is reduced emptying of the upper gastric pouch and control of ingestion. The proximal pouch is almost a continuation of the esophagus and represents a functional continuation toward the jejunum. The use of the stapling instrument in gastric bypass Roux-en-Y has reduced operating time and increased the safety of the operation.
In our series, gastric bypass was used to correct the failure of other gastric reduction procedures. The patients in our gastric bypass series achieved better and faster weight loss than with gastroplasty. Our experience with Roux-en-Y gastric bypass at the lesser curvature and gastroplasty at the lesser curvature confirms that the gastric bypass procedure is superior and is our operation of choice (Figures 2-4).

**Figure 2** Weight loss (pounds) after gastroplasty (interrupted line) and conversion to Roux-en-Y gastric bypass (full line).
Figure 3 Percentage of weight loss after gastroplasty (interrupted line) and conversion to Roux-en-Y gastric bypass (full line).
Figure 4 Excess weight (percentage) after gastroplasty (interrupted line) and conversion to Roux-en-Y gastric bypass (full line). Weight is checked every three months.
References

Discussion of Gastric Bypass, Moderator: Joseph A. Buckwalter, M.D.

BUCKWALTER: Dr. Crowley, you have added a sobering note to gastric bypass. Do you feel that all patients treated by gastric bypass, including the kind that Dr. Torres has just described, should receive supplements of vitamins, iron, B₁₂ and calcium?

CROWLEY: Yes, I think when one does any sort of procedure on the stomach that greatly reduces gastric capacity, and particularly if bypass of the duodenal loop is included, the patient will be at a very serious metabolic disadvantage. Therefore problems of negative calcium balance, with iron intake, are compounded. Patients can't eat the diversity of foods they used to eat. They should all be followed up over the long term. They all should have supplements, they all need iron, and they all should be on supplementary calcium.

QUESTION: Should patients take vitamin D supplements? Do you have calcium balance studies on your patients?

CROWLEY: No, we have no calcium balance studies on any of the patients. We have dietary intake studies on these patients and, of course, if they can't take dairy products then their intake of calcium is very low. Some vegetables contain calcium. Dietitians can work out an adequate calcium diet without milk or dairy products, but it's difficult. Dairy products are usually fortified with vitamin D. Patients who can take dairy products probably wouldn't need extra vitamin D. Patients can usually get enough absorption of vitamin B₁₂ by oral route if given enough. Only about 1-2% of what they take is absorbed. It may be more cost-effective and easier to shift to vitamin B₁₂ injections, but that's a matter of personal preference.

COMMENT: Dr. Solochek states he has followed up 75% of his patients. One of the previous speakers didn't mention his follow-up percentage. It's extremely difficult to keep contact with all of these patients, especially in a large series. Dr. Joel Freeman has stated that patients who are lost to follow-up study are those who have done very poorly. He suggests they are either angry with their surgeon because they've not done well or they feel guilty. These losses to follow-up study are disastrous and must be considered.

RESPONSE: We had a series of patients who had not returned for follow-up visits. We finally got them back in and it turned out that only 50% were
doing poorly. The other 50% had done perfectly well. We try very hard to get long-term data. We beg people to come back. We send them letters, self-addressed envelops, little cards, we call them up every night. Complete follow-up records, especially in a large series, are extremely difficult, if not impossible, to maintain.

COMMENT: Dr. Crowley's going to have to do a lot better job of convincing me that a half-inch or inch height loss is significant. These people lose 20-30 inches from their abdominal girth. Their shoe size may change two sizes. I suspect that subcutaneous fat loss both from the soles of the feet and the scalp certainly could account for a half-inch or even an inch loss in height.

CROWLEY: The question is whether the loss in height results from a loss of fat. I don't think so. I think it occurs over time and is related to a skeletal problem. I think it may be an accelerated, if you will, post-menopausal osteoporosis in premenopausal women. I think it goes with musculoskeletal problems. I think some of these patients have features that also suggest that they are osteoporotic. Unless the patients take calcium supplements, many are in tremendous negative calcium balance. I don't have metabolic studies, but my inclination is to say that these big height losses are probably musculoskeletal rather than loss of body fat.

COMMENT: I think adding a gastrostomy is a short procedure that can prevent distention and can aid in the treatment of patients with temporary outlet obstruction, and I recommend them.

LECHNER: A few of my patients' problems would have been alleviated by gastrostomies, but not cured. I think we must take into account the risk of adding gastrostomy, especially since 99% of patients get by perfectly well without one.

QUESTION: I can understand a B₁₂ deficiency after gastric bypass. Why do they occur after a gastroplasty procedure?

CROWLEY: I've had no experience with this. My study involved patients who had had gastric bypass with loop gastroenterostomy.

PRINTEN: Do you know how many of your patients were deficient in B₁₂ and folate before operation?

CROWLEY: We don't have any data on the patients prior to operation. Many of these people date back to 1974 and at this time we were unaware of some of these problems. Some data has been published relating to
this, and it is true that some of these people's intakes may be deficient in $B_{12}$ owing to their eating problems. However, I think that dietary $B_{12}$ deficiency in a patient with an intact stomach is quite rare.

COWAN: (George Cowan, Memphis, Tennessee.) I would like to compliment the speakers on their fine papers. I would like to comment, also, on gastric outlet obstruction acutely postoperatively. One patient that I performed a Roux-Y to the lesser curvature postop day 7 had severe colicky pains, on erect film of the abdomen had air fluid level of the distal stomach treated with Reglan and did so chronically for several weeks and this resolved. We did not need to do any gastrostomy, reoperation, what have you. I wonder if there has been any similar use of this to help alleviate presumptively the pylorospasm and/or associated gastroparesis with this? Secondly, on Dr. Crowley's comments and talk, which I thought pointed out some very serious problems with all obesity surgery procedures, that should direct each and every one of us postoperatively and preoperatively to commit ourselves for lifelong follow-up of these patients. It is not good enough, gentlemen, for five-year follow-up, two-year follow-up. I heard at our meeting last year something like 50% follow-up at six months in one unfortunate series. This is gross, it's unacceptable, and we need to follow these patients for life for these reasons, regardless of the procedure, and I think we need to assimilate this into an ethical position of our Bariatric Society at some point, and the sooner the better. There are a number of preoperative abnormalities. I have seen a zinc deficiency. One would think that these patients, being so well-fed, would be normal in every way as far as their nutrition is concerned, but this is not the case. The majority of them have abnormal livers. Indeed, liver biopsies confirm that over 70% have fatty infiltration of the liver, and many are close to cirrhotic. I presume that their low serum zinc levels are related to liver problems. I'm not at all surprised that there are other preoperative abnormalities.

HOLLENBERG: (Jacob Hollenberg, Winnipeg.) In Canada we are required by law to do preoperative gastrin, folic acid, and magnesium estimations and follow them up on a regular postoperative basis. This isn't at our desire, but rather the desire of the Royal College of Physicians and Surgeons. We have found that some of these individuals, in whom we are doing the Roux-en-Y gastric bypasses, with very few complications, are
hypogastrinemic postoperatively. These are the ones who require the \( B_{12} \) injections which they receive on a monthly basis. We also give them calcium. We follow their magnesium levels. We give them ditachyhydrosterol to complement the calcium as well as fluoride to prevent the osteoporosis. This mainly occurs in women.

CROWLEY: Dr. Mason's group noted that serum gastrin levels fall and gastrin response to food intake is reduced after gastric bypass. Gastrin stimulates acid and probably intrinsic factor as well because they are made by the same cell. Consequently, both fall after the gastric bypass.

BABCOCK: (Warren Babcock, Rockford, Illinois.) I've done 750 gastric bypasses and I still transect the stomach. By transecting the stomach, it's very easy to mobilize the distal stomach and insert a gastrostomy. It will not leak, and I have not had any complications. I'm aware of people who died prior to doing gastrostomy, and I feel we should use them in the distal stomach if at all possible. It's an insurance policy that's very inexpensive.

QUESTION: Dr. Torres, what was the percentage of failure of the lesser curve gastroplasties in your experience?

TORRES: I mentioned that 31% of the patients had failed and 20% of those were converted to gastric bypass.

BUCKWALTER: Dr. Solochek raised the question of Marlex versus silastic. How many people have seen the Marlex erode or produce obstruction in vertical banded gastroplasty or in other areas?

O'LEARY: (Patrick O'Leary, Dallas, Texas.) I've seen it happen three times.

BUCKWALTER: How many others have seen it? Is this common enough to abandon Marlex?

MASON: I used Marlex mesh on the greater curvature and gave it up because I had some problems with it. Then we moved over to the lesser curvature. We now have about 340 patients at The University of Iowa without any erosions. I think the difference is that the stomach is thicker on the lesser curvature. We don't divide a single vessel, we do very little dissection and we have a minimum of opportunity for contamination. These things all add up to greater safety and less obstruction. I would guess that Marlex mesh around an anastomosis after a more complicated operation would cause trouble, and I wouldn't recommend it for that.
TERRY: One of the most interesting advances we have observed over the past several years has been biliopancreatic bypass, introduced by Dr. Nicola Scopinaro. It is an operation that has overtones of the intestinal bypass era, and we are curious about its relationship with the intestinal bypass. It provokes some controversy in our midst. A show of hands reveals nine surgeons at the conference who have had some experience with it.
EARLY RESULTS AND COMPLICATIONS WITH MOST RECENT TECHNIQUE OF BILIOPANCREATIC BYPASS
Nicola Scopinaro; E. Gianetta, D. Civalleri, U. Bonalumi, D. Friedman, and V. Bachi

The latest model of partial biliopancreatic bypass (BPB) differs from the previous types ("half-half" (HH), 40 cases, and "short-loop" (SL), 43 cases, types: hemigastrectomy and half the length of the small bowel or 200 cm in the alimentary tract) in the extent of the gastrectomy, which was greatly enlarged in order to reduce the incidence of stomal ulcer and to increase the weight loss during the first postoperative months. In all cases the stomach was closed and sectioned using a TA 90 stapler and the gastroenterostomy made on the left corner of the gastric stump. In a first series of 52 patients (little stomach, LS) the dissection of the greater curvature was interrupted at the level of the last one or two short gastric vessels, thus leaving a measured gastric volume of 300 to 400 ml (mean: 317 ml). In the most recent series of 91 patients (very little stomach, VLS) the complete dissection of the stomach from the spleen allowed placement of the gastroenterostomy at the 200-cm level leaving a gastric volume of no more than 200 ml (mean: 112 ml).

Mean preoperative overweight was 95% in the LS group and 107% in the VLS group versus 83% and 87% in the HH and SL groups. The excess weight loss was 43±12% (51 cases) in the LS and 47±14% (39 cases) in the VLS groups at three months, 61±16% (51 cases) in the LS and 61±14% (5 cases) in the VLS groups at six months, and 80±16% (26 cases) and 85±13% (8 cases) in the LS group at 12 and 18 months. This is a markedly greater weight loss than that obtained with the HH and SL types (70% and 75% respectively at the time of weight stabilization), especially when the higher mean preoperative weight is considered. All the other beneficial effects which followed the LS and VLS bypass were very similar to those observed after the previous types. There were three deaths due to general complications and two GEA leaks in the 143 patients submitted to the latest types of BPB. Deaths or leaks did not occur in the 83 cases with the previous types. Vomiting during the first postoperative months (very rare after the previous types) was very common following the latest types, the nonsurgical rehospitalization rate was 8.5% (6.0% after the
previous types), and 6.0% of the operated patients had a hypoproteinemia requiring intravenous aminoacid supplementation (6.0% after the previous types). No additional late complications occurred following the latest types of BPB, and the incidence of stomal ulcer was reduced to zero (8.4% after the previous types).

It is concluded that the present type of partial BPB, in comparison with the old types, results in a greater weight loss and in the disappearance of one of the few late complications of the procedure. These better results are paid with an increase in operative mortality and in the incidence of major surgical complications.
DUODENOILEAL BYPASS FOR MORBID OBESITY
Howard E. Dorton, M.D.

RESUME

Duodenoileal bypass which creates a direct passage for food and chyme as it leaves the duodenum to enter the last sixty centimeters of terminal ileum has been performed on sixty obese patients during the past three years. It is relatively easy to perform, has few side effects and has produced a satisfactory sustained 37% weight loss. It does this by significantly suppressing appetite and by reducing caloric absorption. Most importantly, it preserves ileal resorptive function, thereby preventing diarrhea and fluid, electrolyte, and mineral depletion. Blind loop syndrome has not occurred and there has been no clinical evidence of liver damage.

INTRODUCTION

The purpose of this paper is to describe a new operative procedure, duodenoileal bypass, which has been found to be effective in producing weight loss without causing serious side effects. It does this by causing appetite suppression as well as by reducing caloric absorption. Most importantly, ileal resorptive function is preserved to a large degree and blind loop syndrome is avoided. An average of 37% weight loss has been achieved within 18 months. There has been little tendency for patients to regain weight during this three-year period.

The rationale of the procedure is based, in part, upon the experimental work of Koopmans and Sclafani in rats, Kral in dogs, and in humans by ourselves. These experiments have shown that food and chyme in early contact with a segment of terminal ileum which has been transferred to the proximal jejunum produces satiety signals that cause a definite decrease in food intake (Fig. 1).
Koopmans and Sclafani, who first demonstrated this effect in obese rats in 1980, postulate that the gut hormones, enteroglucagon and neurotensin, are released and are responsible for suppression of the appetite. We have found this appetite suppression to persist for eight to 14 months in humans (Table 1), but we have not found it to be sufficiently effective or predictable enough to warrant its use as the sole procedure in the treatment of morbid obesity.
TABLE 1
EFFECTS OF ILEAL INTERPOSITION ON FOUR HUMAN SUBJECTS

<table>
<thead>
<tr>
<th>AGE/SEX</th>
<th>INDICATION FOR SURGERY</th>
<th>PRIMARY OPERATION</th>
<th>ADDITIONAL SURGERY</th>
<th>PREOP. WEIGHT IN LBS.</th>
<th>CURRENT WEIGHT IN LBS.</th>
<th>% LOST</th>
<th>MONTHS POSTOP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 yr F</td>
<td>Duodenal ulcer</td>
<td>Vagotomy</td>
<td>ileal interposition</td>
<td>200</td>
<td>118</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>33 yr F</td>
<td>Gallstones</td>
<td>Cholecystectomy</td>
<td>I.I.</td>
<td>318</td>
<td>224</td>
<td>28</td>
<td>27</td>
</tr>
<tr>
<td>51 yr F</td>
<td>Hiatal hernia</td>
<td>Repair hiatal hernia</td>
<td>I.I.</td>
<td>215</td>
<td>159</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>28 yr F</td>
<td>Ventral hernia</td>
<td>Repair ventral hernia</td>
<td>I.I.</td>
<td>265</td>
<td>250</td>
<td>5</td>
<td>15</td>
</tr>
</tbody>
</table>

We have found that this principle when combined with bypass of all but 60 cm of terminal ileum (Fig. 2) has produced satisfactory and sustained weight loss in humans for periods up to 36 months. Retention of 60 cm of terminal ileum appears to be sufficient to preserve enough of its all important resorptive function to avoid significant losses of fluids, bile, electrolytes, vitamins and minerals which are essential to the body economy.
TECHNIQUE

The technique is simple and relatively easy to perform, even in the markedly obese (Fig. 2).

Figure 2. Duodenoileal bypass, a three step procedure
The belly is entered through a generous transverse supraumbilical incision transecting the right rectus muscle and the left rectus fascia. A plastic ring wound protector is used to minimize wound contamination. A mucosal barrier valve (pseudopylorus) is then constructed in the ileum 60 cm proximal to the ileocecal junction. The ligament of Treitz is then exposed by firm cephalad retraction of the upper wound margin. The ileal valve is then sutured to the beginning of the jejunum. The ileum just distal to the valve is anastomosed side-to-side to the adjacent jejunum with the GI stapler. After checking the staple line for bleeding, the instrument openings are closed, taking care not to compromise outflow into the ileum. The jejunum just distal to this anastomosis is then divided with the GIA instrument, and the stapled divided ends of the jejunum are approximated with a few sutures to prevent subsequent intussusception of the proximal blind loop. This creates a direct passage for food and chyme as it leaves the duodenum to enter the last 60 cm of terminal ileum. The adjacent mucosal barrier valve effectively prevents significant backwash of nutrients into the bypassed bowel, as has been demonstrated repeatedly by postoperative barium studies. Also, abdominal x-rays have never shown gas in the bypassed bowel as was seen so often following standard jejunoileal bypass.

To date this effect has been attained in sixty patients with no mortality and minimal operative and postoperative morbidity. After the first two or three weeks there has been no significant diarrhea or significant depletion of fluids, electrolytes, or minerals. A few patients have had mild easily correctable hypokalemia. Liver function studies have revealed mild transient elevation of liver enzymes but no elevation of serum bilirubin and no clinical evidence of liver damage. A few liver biopsies have shown no significant increase in fatty infiltration over that seen preoperatively. Only one patient has had ureteral calculus which occurred ten months after operation.
RESULTS
This operation has been performed on sixty obese patients since 1980 (Table 2). One patient had a minor wound infection. Two patients have developed small incisional hernias. There have been no venous complications. One patient underwent reoperation to correct a stricture of the anastomosis.

TABLE 2
MORBIDITY OF DUODENOILEAL BYPASS - SIXTY PATIENTS
- No mortality
- No venous complications
- No respiratory complications
- Wound infection - 1
- Reoperation - 1 (revision of anastomosis)
- Incisional hernia - 2
- Ureteral calculus - 1 (10 mos postop)
- Average postop hospital stay - 6 days

Thirty-two of these patients have been followed up for more than 18 months (Table 3). Their mean preoperative weight was 116 kg (range 91-230 kg). The mean weight loss was 43 kg (range 26-106 kg). The remaining 28 patients are responding in a similar fashion.

TABLE 3
WEIGHT LOSS FOLLOWING DUODENOILEAL BYPASS - SIXTY PATIENTS
- Average preop weight - 116 kg (91 kg-230 kg)
  - 32 patients followed more than 18 months
    - Average weight loss - 43 kg (26 kg-106 kg)
  - 28 patients followed less than 18 months
    - Responding in similar fashion

DISCUSSION
The ideal operation for correction of morbid obesity should produce permanent satisfactory weight loss and minimal interference with body economy. It should be relatively easy to perform, have minimal morbidity, and be free of unpleasant side effects. It should not be
dependent upon anatomical alterations which are difficult to attain or maintain, or impose bizarre restrictions on eating habits.

Duodenoileal bypass appears to achieve these goals. Because of its ease of performance, relative lack of side effects, and effective production of weight loss, it seems justified to continue investigating this procedure in order to obtain longer observation in greater number of patients. If the procedure stands the test of time it may cause a revival of interest in intestinal bypass for morbid obesity.

REFERENCES

Discussion of Biliopancreatic and Duodenal Bypass; Moderator: Dr. Boyd E. Terry

TERRY: Over the long-term will either of these procedures cause unusual bacterial overgrowth or other bowel problems? Have you been measuring B₁₂ levels in your patients? Do either of the procedures cause changes in macronutrients or vitamin levels?

SCOPINARO: I don't think there are enough patients with B₁₂ deficiency to cause concern.

COMMENT: If we have 75% follow-up at best, we're going to be losing a lot of the patients who may be B₁₂ deficient. I'm afraid later on we may see a lot of patients with difficulties in walking owing to a proprioceptive sensory loss as well as B₁₂ megaloblastic anemias.

SCOPINARO: Vitamin B₁₂ absorption is not a problem after the biliopancreatic bypass. Not only have we never had one case of macrocytic anemia, but we have done Schilling tests in at least 20 cases after the partial type of procedure and the absorption of the B₁₂ vitamins has always been normal. Of course, I don't have any longer follow-up than eight years, so I can't say what's going to happen in the future, but for the moment we haven't had any vitamin B₁₂ deficiency.

PRINTEN: Could you tell us what kind of protocol you use in following up these patients?

DORTON: Let me answer first the question about the blind loop syndrome. The strategically placed valve just proximal to the anastomosis prevents backwash of nutrients into the blind loop, as we have demonstrated repeatedly on barium studies. Also, subsequent abdominal x-rays have never shown gas to accumulate in the small bowel as was so commonly seen and so troublesome after the old J-I bypass, where the blind loop was drained into the colon. The gut at the level of this anastomosis is relatively free of bacteria. Bacteria coming in from above are usually killed off by gastric acidity. We've not seen any symptoms of bacterial overgrowth and no clinical evidence or laboratory evidence of liver damage. In regard to follow-up study, I see patients once a week for the first four weeks after operation, then every other week for a month, and then every month for the next three or four months, and finally at two or three month intervals for the next three years. Each time they come in I ask them a set number of questions. First I ask them how many bowel
movements they're having, and they usually report one to two per day. I ask them about their appetite. Most get just as hungry as before, but they are very easily satisfied with a small amount of food. I inquire as to numbness around the face or fingers. A few will develop a little numbness or a little tingling in their fingers, but this is easily corrected by advising them to drink a glass of milk a day. Rarely are calcium supplements required. I look for potassium depletion. If they show any weakness I give them supplementary potassium with instructions to take it for a few days until their strength returns. I check for belly cramping and the blind loop syndrome. Of course, I also ask whether the patient is satisfied, and most of them are.

PRINTEN: Having gotten that subjective data from the patients, what objective tests do you measure?

DORTON: In addition to general clinical observations, I check their blood pressure and ask about any diabetic medication requirements.

PRINTEN: How about liver function studies, serum calcium, and things like that?

DORTON: I check their serum bilirubin.

PRINTEN: But you really don't objectively measure any of those when they come to your office?

DORTON: No, not unless there might be some reason for me to suspect liver damage.

DRENICK: (Dr. Ernst Drenick, Los Angeles.) Dr. Dorton, if I understood you correctly, you said that follow-up liver biopsies showed no change in degree of fatty infiltration compared to baseline. Is that correct?

DORTON: That is correct.

DRENICK: I wonder if this could actually be an early signal of liver impairment. With gastric reduction operations and subsequent weight loss, there is an almost universal diminution of steatosis of the liver. In patients with intestinal bypass, one of the earliest signs that something may be going wrong with the liver is the fact that liver fat not only does not disappear but does increase. In your follow-up plans, do you envision doing liver biopsies, at least for the first two or three years? Liver function tests are not very sensitive to early signs of deterioration of liver histology. I agree with you that putting in a valve will probably reduce influx of nutrients into the blind loop, but
it cannot prevent bacteria from growing in the blind loop. We know that following intestinal bypasses a fair percentage of individuals develop enteritis symptoms and systemic secondary symptoms five, and even ten years after being relatively symptomless.

DORTON: What you say is quite true, and I must confess that we have not done liver biopsies. I'm a little reluctant to subject my patients in private practice to a very uncomfortable procedure just to satisfy myself if the patient appears to be doing well. I think it should be done, and at the suggestion of yourself and also Dr. John Kral we may follow that plan more closely.
METABOLIC SEQUELAE OF GASTRIC RESTRICTIVE OPERATIONS
John D. Halverson, M.D.

INTRODUCTION

Since the publication by Mason and Ito in 1969 describing gastric bypass, gastric restriction surgery has largely replaced jejunoileal bypass surgery for morbid obesity, in part because it has been largely free of metabolic sequellae. On the other hand, common sense dictates that a patient who undergoes a weight loss of 75-150 lbs in the year or two following an operation must be at some metabolic risk. Despite this, most reports on gastric restriction operations for obesity have consisted, until recently, of technical innovations and reports of weight loss and immediate complications of the operation. Aside from a few reports of vitamin deficiencies and anemia, few studies before 1981 dealt with the metabolic price paid by patients undergoing gastric stapling for obesity. Recently, more concern has been directed to the metabolic status of the gastric restriction patients, and an analysis of the postoperative metabolic status of these patients is now possible.

PROTEIN METABOLISM

In 1970, Cahill described energy economy in starvation and the metabolic adaptation that occurs when the starvation is prolonged. It is clear that acute starvation produces rapid depletion of carbohydrate stores, following which, temporarily, energy requirements (particularly those of the central nervous system) are met by glucose synthesis using carbon chains derived from the breakdown of protein stores. With time, the entire body becomes more capable of deriving its energy requirements from products of lipolysis, and the specific metabolic demands of the central nervous system can ultimately be met by those products, decreasing the need for carbon chains derived from protein. This adaptation results in a net conservation of protein mass and instead, depletion of fat stores.

Gastric restriction operations may produce long-term caloric deprivation and massive weight loss. On the other hand, the incidence of protein-carbohydrate malnutrition after any of these procedures is rare unless high-grade obstruction of the outflow tract from the proximal pouch has occurred. In fact, throughout the years that we have carried out gastric bypass, we have seen very few patients with even low serum
albumin and total protein or low cholesterol levels. Moreover, the excessive weight loss and presumed lean body mass depletion that we see frequently after intestinal bypass and was associated with debilitating fatigue is not seen after gastric stapling.6,7

While the gastric restriction patient has oral intake estimated to be 500-800 calories per day immediately after operation, these patients are potentially exposed to the risks of starvation by virtue of the massive weight loss they incur. In 1981, Palombo7 showed significant lean body mass depletion immediately after operation. However, the metabolic adaptations described above apparently occur in these patients since, by the end of eighteen months, only 2% of the lean body mass had been lost (most of the weight loss having come from fat stores). MacLean6 confirmed this observation using multiple isotope dilution techniques in a group of patients on a controlled diet with vitamin supplementation. Subsequently, in a larger group of patients (not all of whom had adequate oral intake), MacLean reported an abnormally high exchangeable sodium to exchangeable potassium ratio8 signifying malnutrition. These patients lost somewhat more weight than did those patients who were not "malnourished," and they more frequently exhibited vitamin deficiencies. Thus, even in a patient who is apparently doing reasonably well postoperatively, the threat of protein/carbohydrate malnutrition is real unless positive steps are taken to insure a calorically adequate diet containing sufficient protein and micronutrients.

FAT METABOLISM

Palombo's study showing massive fat depletion after gastric stapling correlates well with a number of studies of fat metabolism postoperatively in gastric restriction patients. Morbidly obese patients manifest abnormal fat metabolism by the high incidence of fatty metamorphosis in their livers.9 However, steatosis in the liver of morbidly obese patients decreases significantly after gastric bypass.3 Moreover, Evenson et al10 have shown that hepatic incorporation of 14C-acetate into digitonin-precipitable sterols in postoperative patients does not differ from that of controls. Further, several reports11,12,13 have now documented a decrease in total cholesterol and triglyceride in postoperative patients, together with a decrease in cholesterol and
triglyceride in postoperative patients, together with a decrease in cholesterol low density lipoprotein (LDL) and an increase in cholesterol high density protein (HDL). In addition, Gonen et al.\textsuperscript{11} have shown an increase in the HDL/LDL ratio and parallel changes in apoprotein A-1, A-2, and -B. While these studies have not shown an actual decrease in the risk for atherosclerosis in morbidly obese patients who undergo gastric stapling, the changes in lipid metabolism which have been reported might be inferred to place these patients in a lower risk group.

CARBOHYDRATE METABOLISM

There is now abundant evidence that carbohydrate metabolism also changes drastically after gastric stapling. For many years, there have been reports of a decrease in insulin requirement or in the requirement for oral hypoglycemic agents.\textsuperscript{14,15,16} Recently, Herbst\textsuperscript{15} has demonstrated improved hemoglobin Hbg A\textsubscript{1}C levels, increased glucose tolerance and decreased insulin resistance in postoperative patients. Kramer and others\textsuperscript{17} have shown increased insulin binding to receptors on mononuclear blood cells after gastric bypass, providing a partial explanation for the improved glucose tolerance seen in that group of patients.\textsuperscript{16} While clinically significant hypoglycemia is rare postoperatively,\textsuperscript{16,18} a provocative oral glucose load in a postoperative gastric bypass patient produces hypoglycemia with symptoms in most patients. Thus, a postoperative patient not only is likely to improve glucose handling (if they are diabetic or merely have abnormal glucose tolerance curves), but are sufficiently sensitive to the effects of insulin to actually become hyperglycemic if presented with a sufficient glucose load.

MINERAL ABNORMALITIES

The incidence of electrolyte abnormalities after the gastric restriction procedures has been infrequently reported. A recent report\textsuperscript{19} details the results of long-term metabolic screening in a large group of gastric bypass patients and reports a high incidence of potassium and magnesium deficiency (56% and 34% respectively), but with no significant clinical sequellae. The magnesium deficiency was transient and rarely treated, and the potassium deficiency was almost always associated with diuretic use (and responsive to therapy).
Hypocalcemia rarely occurs, although we have seen some evidence that calcium intake after gastric restriction procedures is quantitatively insufficient to sustain normal mineral homeostasis, carrying with it a risk of skeletal depletion of calcium (unpublished data). We have seen mild osteomalacia in one patient within one year after gastric bypass, and we are currently studying a large group of patients with postoperative vitamin D deficiency in an effort to determine whether skeletal changes occur after gastric bypass as they do with a predictable incidence after gastric surgery in general.

Iron deficiency after gastric bypass is common and may be associated with a postoperative anemia. Treatment has been problematic in a few patients.

**VITAMIN DEFICIENCIES**

Several years ago deficiencies of the water-soluble, B-vitamin series were anecdotally reported. More recently, MacLean has reported folic acid and B12 deficiency, but without apparent clinical sequelae. Moreover, there are now reports describing anemia and neurologic sequelae which might be related to metabolic deficiencies following gastric restriction procedures for obesity.

The necessity for vitamin supplementation after gastric restriction should be implicit in the significant reduction of food intake that occurs with these operations. Nonetheless, the necessity of such supplementation is still argued, and only recently has the incidence of vitamin deficiency been reported in a large series of patients.

At Washington University in St. Louis, 73 patients having a gastric bypass were assessed prospectively over several years, and the incidence of vitamin deficiency was high (Table 1). At regular postoperative intervals, water-soluble and fat-soluble vitamins were measured. Nearly two-thirds of patients developed vitamin B12 deficiency (mean 28 months after operation), and nearly 40% developed folic acid deficiency (mean 15 months after operation). These deficiencies, as with other vitamin deficiencies seen, were treated immediately, and clinically significant sequelae have been rare. We have not seen clinically significant thiamine deficiency, and several patients with vitamin D deficiency are currently being studied to assess mineral homeostasis. Vitamin A
deficiency, although common (27% of patients), has not resulted in night
blindness in any patient.

Table 1

<table>
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<tr>
<th></th>
<th>% abnormal</th>
<th>Mean month first detected</th>
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<tr>
<td>potassium</td>
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<td>K (prothrombin time)</td>
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Clinically significant syndromes owing to vitamin deficiencies are
now being reported after gastric restriction procedures. Griffen 14
reported anemia in 5% of his patients, most having had microcytic
hypochromic indices without evidence of blood loss. These patients were
treated successfully with iron. Griffen also reported that three
patients developed a macrocytic anemia apparently related to vitamin B12
deficiency.

At Washington University, over one-third of our patients were anemic
postoperatively (those who were anemic owing to blood loss at operation
were excluded). In most cases, the anemia was due to gynecologic
problems, other operations, or in one case, a bleeding ulcer in the
distal gastric pouch. However, about 10% of our patients developed
anemia apparently as a result of deficiencies of the bypass operation.
In this group, patients were either iron deficient, B12 deficient, or
folic acid deficient (or combinations of these). While MacLean 8 has not
seen anemia associated with these deficiencies, there is little question
that the magnitude of the deficiencies we have observed might lead to
anemia if inadequately treated.

The most serious metabolic deficiencies we have seen in gastric
restriction patients have been in patients having outflow tract
obstruction. One such patient 24 developed profound anemia and
malnutrition after her gastroplasty outflow tract obstructed following revision to tighten it. Despite the anemia, the patient had a reticulocyte count of one, and bone marrow biopsy revealed suppression of marrow function attributed to folic acid and vitamin B₁₂ deficiency.

Recently a number of reports²⁰,²¹,²²,²³ have reported a Wernicke-Korsakoff syndrome thought to be due to thiamine deficiency. While the deficiency itself was not documented, the classic features of the syndrome, together with the history (in most) of vomiting, together with the response to thiamine therapy, has implicated a deficiency in that vitamin as being the cause of the syndrome. MacLean's report⁸ actually documents thiamine deficiency in gastric restriction patients, one of whom also developed lower extremity weakness. At Washington University, we have seen neither thiamine deficiency nor neurologic sequelae of the gastric bypass.

The emergence of a neurologic syndrome (after gastric restriction) seemingly related to thiamine deficiency further emphasizes the need for vitamin supplementation postoperatively in these patients. Interestingly, a lack of such supplementation has inevitably become the subject of litigation in several states.

IMMUNOLOGIC COMPLICATIONS

When the outflow tract from a gastric restriction pouch becomes obstructed, intake of all nutrients may cease, or more commonly, the patient may subsist on a poor-quality liquid diet alternating with episodes of emesis. The danger posed by this series of events is demonstrated by the development of the neurologic syndromes discussed above. Further, malnutrition may progress to such a degree that the patient's life may actually be threatened, whether by weakness and malnutrition per se, by the attendant vitamin deficiencies and their sequelae, or, as we have seen in one case, by infection. We have seen a patient who developed a high grade obstruction of the gastric pouch outlet after her surgeon tightened her dilated stoma, after which the patient lost catastrophic amounts of weight, became cachectic, and ultimately developed cutaneous anergy.²⁴ A catheter infection during a course of total parenteral nutrition nearly cost her life, and her immune system returned to normal only with several weeks of TPN.
SUMMARY

It is clear that the metabolic risks of gastric restriction procedures include those that occur soon postoperatively (and consist largely of fluid and electrolyte problems) and those that occur over a longer period, consisting mainly of vitamin deficiencies and, rarely, malnutrition due to prolonged emesis or obstruction of the outflow tract. The risk of these complications is real and necessitates close postoperative follow-up scrutiny, both near term and over the years after a patient has reached a weight plateau.

BIBLIOGRAPHY

19. Metabolism paper (consult author for details)
Table 2 - Metabolic Complications of gastric restriction surgery for morbid obesity

<table>
<thead>
<tr>
<th>COMPLICATION</th>
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TERRY: Are there any questions of Dr. Halverson? Yes? We have just a few minutes.

QUESTION: Does the length of the limb make any difference with Roux-en-Y gastric bypass?
HALVERSON: Our patients all had loop gastric bypasses. I've not done Roux-en-Y, but I suspect that the results would be similar. Abnormalities would probably be somewhat less frequent with gastroplasies, but nobody has yet shown that.

QUESTION: Do you continue prophylactic treatment with multivitamins indefinitely after operation? Since you identified primarily chemical rather than clinically significant deficiencies, have you given any thought to doing a prospective study of treated and untreated patients?
HALVERSON: We have not. Although there isn't enough data yet that would suggest multivitamin supplementation is necessary, we recommend it indefinitely.

QUESTION: Dr. Halverson, you noted 50% of patients with abnormal potassium. Were these patients hypokalemic or hyperkalemic?
HALVERSON: Hypokalemic. For the most part they were patients who had been placed on diuretics by their local physicians, usually without my knowledge. The hypokalemia was usually transient. As soon as we would pick it up we would either take the patient off the diuretic if it wasn't really warranted or treat the hypokalemia.

KRAL: I would like to mention that in my series of vertical banded gastroplasies, in spite of iron and multivitamin supplementation, 30-40% of patients have iron deficiency. I want to warn against complacency among surgeons who use vertical banded gastroplasty versus gastric bypass.

HALVERSON: I agree. Some of these problems, such as vitamin $B_{12}$ deficiency, don't show up for two to three years. We have to be careful and keep looking over the long term.

DRENNICK: It's been known for a long time that fasting individuals develop hyperuricemia and gout, and can even develop urate nephropathy. Patients who eat very little or eat little and vomit will develop a similar picture, although probably not as severe. We can prevent it by using Allopurinol or Benamid that will artificially lower the uric acid
levels. We can also try to increase the glucose and carbohydrate intake, which will permit more efficient metabolism of fatty acids.

TERRY: Our tendency is to think of weight loss as our only goal. We make the pouches so small that we may have gone beyond the point where the patient can have adequate nutrition.

RANK: (Dr. Dale Rank, Arlington, Texas.) Vitamin and mineral deficiencies are relatively easy to correct, but is protein deficiency with consequent loss of lean body mass perhaps an even larger problem?

HALVERSON: That has not been a problem. There are four or five studies that demonstrate that, with proper follow-up care, lean body mass depletion is not a problem after gastric restriction procedures, at least as carried out by the institutions that reported those results. However, patients must be given proper instructions not only in how to eat, but also in correct nutrition. As alarmed as we might be about the risk of lean body mass depletion, the evidence is good that it does not occur except under certain circumstances, such as protracted vomiting or complete carelessness with diet.
Cornelius Doherty: Moderator, Gastric Banding Session

Gastric banding was tried by Dr. Larry Wilkinson in New Mexico. Later Dr. John Bookwalter in Brattleboro, Vermont, tried banding with pacemaker wire. Finally banding was abandoned. In 1980, simultaneously and unbeknownst to each other, Dr. Kolle and Dr. Molina started a series of gastric bandings. Shortly after that Drs. Granström and Backman in Sweden carried out some work with banding and Dr. Kuzmak visited Dr. Kolle and introduced banding in the New Jersey area. This procedure is based on gastric restriction and its goal is to be safe, effective, physiologic, easily reversible and economic. It still is in evolution, and our panel today are the great contributors in this evolution.
SILICONE-BANDING: A PRELIMINARY REPORT
Lubomyr I. Kuzmak, M.D.

Since February, 1983, 43 gastric bandings were done using a silicone-dacron reinforced band, made to the author's specifications. Out of the 43 gastric bandings, 31 were done as primary procedures, 10 as a revision of horizontal gastroplasty, one as a revision of vertical (non-banded) gastroplasty and one as a revision of gastric bypass in its original version.

To control the tightness of the band and resulting stomal opening, a special calibrating tube was designed. The end of the tube that is inserted into the stomach has sensitive contacts. They will close circuit and light a three-volt light bulb when the band is too tight. Also, a special banding instrument was designed to make the banding easy.

Two bands were removed at the patients' request. The first was removed eight and a half months after the banding, when the patient decided to return to normal eating habits. The second band was removed six weeks after the banding, due to stomal obstruction secondary to edema caused by vomiting. The patient refused nasogastric decompression of the stomach.

In both patients, the stomach returned to almost normal configuration before they were discharged from the hospital, as proven by gastrointestinal series.

The gastric banding procedure and how it is done is well documented with illustrations, intraoperative photographs and x-rays. Pathological slides are presented on full thickness stomach biopsy on the two patients that had the band removed. The preliminary report on postoperative weight loss is also included.

Gastric banding is simple, less time-consuming, non-invasive and relatively easy to reverse.
GASTRIC BANDING--TEXAS
Marcel Molina, M.D.

Eight hundred* consecutive gastric segmentations were performed between March 31, 1980 and March 31, 1984 in a heterogeneous population of private patients. Female-male ratio was 9:1, age range 14 to 67, the mean excess weight was 95%. One hundred eighty-six patients have been followed up more than 24 months and 400 patients have been followed up for between 12 and 24 months.

**Statistical outline of complications.**
- Postoperative deaths: 2 (0.25%)
- Intraoperative gastric perforations: 5 (0.62%)
- Postoperative perforated ulcer: 1 (0.12%)
- Complete wound dehiscence: 3 (0.37%)
- Intragastric migration of band: 6 (0.75%)
- Rehospitalization rate: 9%
- Revision rate: 8%
- Reversal rate: 13%
- Composite rate of reoperation: 21%

**Special attention was given to:**
- Refinements of technique.
- Medical management of complications.
- Surgical management of complications.
- Technique of revision.
- Technique of reversal.
- Technique of re-do.
- Technique of segmentation performed on patients with other failed gastric restrictive procedures.

*The figures submitted herein are based on our current series of 650 patients with aliquot interpolation of figures to reflect predictable occurrences in 800 cases.
GASTRIC BANDING--NORWAY
Knut Kolle, M.D. and J. O. Stadaas, M.D.

Since October 1981, 121 patients with morbid obesity have been treated with gastric banding. The upper part of the stomach with an inlaying gastric tube is encircled by a vascular graft, 14-mm wide, which is tightened firmly. In the first 46 patients, a gastric tube with a 12-mm diameter was used. In the last 75 patients, a tube diameter of 15 mm has been used.

Average weight loss after six months was 43 kg in the first group and 49 kg after one year. Due to excessive vomiting and serious side effects, the band had to be removed in four patients two to eight months postoperatively. Reversal of the banding was done without problems.

Conclusion:
Gastric banding is an effective weight-reducing procedure. It is technically easy and the gastrointestinal tract is not opened. The possibilities of upper endoscopy and x-ray of the stomach are retained. It may be reversed easily.
COMPLICATIONS AFTER GASTRIC BANDING
Lars Granström, M.D. and Lars Backman, M.D.

The trend in bariatric surgery has been towards easier procedures with shorter operation times and a decreasing mortality and morbidity rate. The easiest procedure so far in the field of bariatric surgery is probably gastric banding. Although easy to perform gastric banding is not free from complications. Instead there have been some new complications which may be related to the banding technique.

At gastric banding only a minimal dissection is necessary to make openings at the greater and lesser curvatures for the 2.5-cm wide Marlex band, which is tightened around the upper part of the stomach. In the first 29 patients a band was tightened around a 25F stomach tube with a force of 7 kilopond. In the last 15 patients we have used a 32F stomach tube and tightened the band with a force of 4 kilopond. In all patients the size of the upper pouch was measured in a standardized way with a thin latex balloon at a pressure above 40 cm of water.

We have so far performed gastric banding in 44 patients with a mean age of 36 years and a mean body weight of 125 kg. A mean Broca's index was 1.87. The observation time varies from one to 32 months.

In our series of 44 patients 30 have done very well, but in 14 patients we have had severe complications which have required rehospitalization and/or reoperation.

We have divided the complications in two subgroups:

1. Unspecified surgical complications which could happen after any kind of general or bariatric surgery: one patient with incisional hernia, two patients with pulmonary embolus and one patient with perforation of the upper pouch with death.

2. Surgical complications related to the banding technique: one patient with penetration of the Marlex band, one patient with kinking of the mesh site and eight patients with a "valve mechanism" with functional stenosis. These complications resulted in eight reoperations and one death.

Penetration of the Marlex band was seen in one patient. The penetration resulted in partial obstruction and the patient was reoperated on with resection of a part of the stomach.
One reoperation was caused by kinking of the mesh site because of adherence to the liver. This resulted in severe vomiting because of an s-shaped stomach with angulation and perhaps also a water seal mechanism. At reoperation the adherence was cut and the band was covered with omentum. Afterwards this patient had no problem with vomiting and had a stable body weight.

Finally we have a so-called pouch dilatation, valve mechanism and functional stenosis syndrome with severe vomiting, which was seen in eight patients. Vomiting is a common symptom in all patients undergoing operative procedures for morbid obesity. However, it seems, at least in our series, that severe vomiting with dehydration and electrolyte disturbances are more common after gastric banding than procedures where staples are used. We have seen hypocalcemia in several patients and neurological symptoms in two patients, secondary to severe vomiting. At first we believed that the severe vomiting was caused by stenosis of the outlet, an outlet created with a 25F stomach tube is smaller than most other surgeons use. However, our first 29 patients had the same dimension of the outlet. Therefore stenosis of the outlet could not be the only factor, even though it was obviously a contributing factor in some patients.

A patient operated on with staples who cannot control his eating habits may eat until the staple line ruptures and will afterwards have a minimal limitation in food intake. It is impossible to eat so much that the Marlex band ruptures. Instead the upper pouch will dilate and this dilatation may result in a valve mechanism of the outlet, resulting in a functional stenosis.
When the upper pouch dilates, the channel part of the stomach protrudes into the upper pouch, resulting in a structure similar to the ileocecal valve.

It is possible that the risk for developing this valve mechanism is greater the bigger the upper pouch is at the time of operation.

Patients with severe vomiting had greater upper pouch volumes (154 ml) than patients who only had minimal problems with vomiting (123 ml). It is important to note that there haven't been any problems in passing a gastroscope with a diameter of 12 mm through the channel in all these patients.

This valve mechanism complication may also occur in patients with small pouches. Patients who could not accept the limitation in food intake after gastric banding had a greater risk for severe vomiting. Actually one patient got into a bulimia-like syndrome sitting at home, drinking, eating and vomiting until he died, probably owing to hypocalcemia secondary to the vomiting.

We really need help from psychiatrists to evaluate which patients we should operate on or not with gastric banding. We perhaps also have to design the operation with regard to the patient's personality. That means that some patients should have operations on the stomach and some others perhaps some kind of intestinal operation.

The conclusions we have drawn from the complications are:

1. A 25F outlet is too small. A 32F outlet is probably better.
2. The size of the upper pouch should be 100 ml or less in order to reduce the risk of developing a valve mechanism of the outlet.
3. Overeating may result in a valve mechanism.
4. Psychiatric evaluation may show that some patients are more suited to operation on the stomach while others should perhaps undergo some kind of intestinal operation.
DOHERTY: More than 1,000 segmentation or banding procedures have been performed by our panel members. I have had the opportunity to visit each of these panelists in their own hospital at least twice and I have communicated closely with them. They have demonstrated two very important things to me that I'd like to share with you. One is that banding is going to have an important place in reoperations for previously failed gastric restriction procedures. The other is that banding, more so even than vertical banded gastroplasty, has emphasized a new phenomenon; the gastric restriction procedure is more unyielding. In the gastric bypass, if the patient wouldn't make the proper eating behavior modification the outlet would eventually and over time accommodate them. In the vertical banded gastroplasty, if patients are willful in the beginning, especially during the first six weeks, they may disrupt the staple line. This opportunity is not apparently available to them in a segmentation or banding procedure, but as our panelists have taught us today, it is now uncovering some new complications. As banding develops, there seem to be four important questions that must be properly answered. The first question is - do you measure the pouch volume and do you measure it under pressure, and what volume and pressure do you prefer?

MOLINA: I do not measure the pouch, I have no choice as to the size of the pouch and it is essentially the same in all patients due to the location of the band.

KUZMAK: I don't measure the pouch, I transect the short gastric vessels, and this gives me a very good estimate of how large the pouch is. You go below the short gastric vessels, it's unpredictable because most of the fundus is just hiding underneath and you don't know where you are going, so I don't measure the pouch.

KOLLE: On the major curve we go between the first and second short vessel, and on the lesser curve we go about 4 cm from the gastroesophageal junction, and then we put the band in that area. This will give you an upper pouch of about 15 ml.

GRANSTROM: We always measure the upper pouch and we try to make a pouch of a size of about 100 ml or less and the range is from 30 to 310 ml, which I think proves it is impossible to estimate the size of the upper pouch created with gastric banding.
DOHERTY: The second question has been partially answered, and that is -
where do you place the band. In the experience to date the band
initially was placed below the hilar vessels of the spleen in Sweden.
Subsequently they have changed. In Norway they place the band through
the middle of the hilar vessels. Dr. Kuzmak removes the superior short
gastric vessels, and Dr. Molina places the band between the gastro-
phrenic ligament and the first superior short gastric vessels. I would
like each of the panelists to comment on the placement line of the band.
MOLINA: The fundamental rationale of the segmentation is effectiveness
coupled with safety. The short gastric vessels should not be disturbed.
We have never had any problem with ruptured spleens necessitating a
secondary operation, and the operation works with the band superior to
the short gastric vessels. I have shown you that it can be performed in
17 minutes, which is the average time, skin-to-skin is 25, and given
that it works, given that it doesn't disturb the anatomical
relationships, I think it is common sense that that is the place where
the band should be.
KUZMAK: I would disagree. I tried all three, and I found that when I
put the band below the first short vessel the pouch was too large. When
I put the band above the first it was too small but the patients were
doing fine and are doing fine, but I don't like to have too small a
pouch or too large a pouch, and I couldn't estimate how large the pouch
really is. A surgeon who transects the short gastric vessels would
agree with me that then you see how much stomach is hiding under the
diaphragm or above the spleen. I do transect above the first gastric
vessels and believe that is the way it should be done.
KOLLE: I am afraid of dividing the vessels on the greater curve because
of loss of blood supply. In Norway experimental studies on cats that
interrupted the circulation on the greater curvature produced necrosis
of the stomach wall, so we save as much of the circulation as possible.
KUZMAK: In my experience I never had any kind of impairment of the
circulation to the stomach. Personally I don't believe that these
vessels are crucial for the circulation in that area. I don't transect
all the short gastric vessels, I just transect the first or second.
GRANSTRÖM: We now put the band just above the short vessels and just
below the left gastric artery, since we noticed a high frequency of
vomiting which we believe is at least partly related to an overly large pouch.

DOHERTY: The third question is - what size outlet do you presently use? MOLINA: With the experience gained on gastric bypass and gastroplasties, we were accustomed to thinking in terms of the stomal size not exceeding 1.2 cm. However, with the banding in which the whole stomach is enclosed, we have to allow for the infolding of the gastric wall. I have learned it is better to think in terms of circumference rather than in terms of diameter, since diameter may be misleading in a patient who has an unusually thick gastric wall. The #32F Ewald or gastric tube gives a baseline on which to gauge the circumference. Experience will allow you to individualize the size on each patient. Generally, if you stay between 6.5-cm circumference on a woman with a rather thin gastric wall and 7.5-cm or rarely 8-cm on a man with a very large thick stomach, you will be right 99% of the time.

BACKMAN: I agree with Dr. Molina that the stoma definitely must be larger than that of gastroplasty. It should be between 12.5-mm and 13-mm in diameter.

KOLLE: Definitely the tube and outlet is important. We tighten the band around a 32F stomach tube. We try to standardize the outlet at 15-mm in diameter.

DOHERTY: The last question is the choice of banding material - why have you chosen the material that you have and why have you discarded the use of other materials?

MOLINA: We chose Dacron because it had been in use clinically since 1957 when Dr. DeBakey first implanted it as a vascular graft. It is well tolerated, there is excellent tissue response to it, and it's tubular in structure which allows me to guide it freely with an instrument in its cavity. It offers a certain degree of adherence to the gastric wall without becoming as impregnated into it as Marlex does, which would prevent its removal if that ever became necessary. At the same time it does not create the pseudomembrane formation such as I have encountered when I tried silicone or silastic. You need adherence to prevent two phenomena: 1) early herniation of the distal stomach (which can happen on a silicone band) leading to an area of necrosis or
ischemia and perforation; and 2) pseudomembrane formation which results in a constricting effect that leads to late stenosis.

KUZMAK: I use silicone and pseudomembranous encapsulation doesn't bother me. I had to remove three bands, and I saw the capsule without any specific reaction. I did full thickness biopsy of the stomach which did not show any kind of changes except for the pressure atrophy of the gastric muscularis. Silicone itself cannot be used because it is expandable, it is like rubber. I use double reinforced Dacron mesh for this band so it cannot expand, and to prevent a herniation, as Dr. Molina mentioned, I oversuture the great curvature. The advantage of silicone is that it is easily removed.

KOLLE: We started with a very hard nylon tape and covered that tape with an arterial graft. Then we decided that the nylon tape was too hard and we now use only the Dacron knitted arterial graft. It is not necessary to have any sutures between the stomach wall and the band. In seven patients on whom we reoperated to cut the band on the front wall of the stomach, there was immediate expansion. We do not remove the band on the back side because cutting it on the front side produces an outlet diameter of about 3-4 cm. Experimental studies have shown that that size has no effect on weight loss at all.

BACKMAN: We started with Marlex because it was a well known material. We feel that adherence of the band to the stomach wall is necessary, otherwise the band may slip upwards or downwards.

SUGERMAN: In looking at the data, the revision rate seems to vary between 8 and 14%. There have been a number of situations where the bands migrated and there have been perforations. But besides that, again there seems to be a lack of information in terms of the total follow-up of these patients. We have compared the vertical banded gastroplasty to the gastric bypass and have noted that a number of patients with a vertical banded procedure can beat that operation by drinking sweet liquids and eating sweet dissolvable simple sugars since they don't develop the dumping syndrome. Have you seen this problem in your patients?

MOLINA: With reference to your comment about follow-up data, we oscillate between 80 and 85% in the first year. However, after the first year it drops. We recognized that by the end of the second year
our follow-up had dropped to 56%, which was frighteningly low. When I discovered this I put all of the office personnel to work on the telephone and sent letters and postcards until we brought it up to the 80-85% level. I am gratified to report to you that surprisingly enough when we completed the follow-up study the people that had not shown up were doing the same as the people who had shown up. Follow-up should be a lifetime commitment. This is something that we try to impress on the patient during the first visit, but we can't force the patients to come back.

With reference to the question of noncompliance or the matter of beating the operation, we all know that patients will not comply. However, with the gastric segmentation we utilize that to our advantage. We instruct the patient not to comply. This satisfies their need, which is innate, and it gives us the result we desire because when the patients eat too fast, too much or don't chew the food well, they develop a discomfort that indicates it is time to stop eating.

GRACE: I'd like to make a comment. I'm concerned about any foreign material around or against the stomach. I am afraid that over the long term, five to ten years, it may erode through the stomach.

TRETBAR: I would like to comment. In gastric banding it is almost impossible to calibrate an opening simply because we are making an accordion in a highly compressible tissue. Also, there is a propensity of the fundal tissue to stretch. It is the thinnest and weakest portion of the stomach. Finally I believe the enormous surface area of the outlet runs a greater risk of swelling due to a gastritis or a viral infection. The smaller simple conduit of gastroplasty, for example, has a very minimal surface area and is less likely to become obstructed during such an episode.
Dr. Mason's early clinical work in gastric surgery for morbid obesity included the performance of a horizontal greater curvature gastroplasty.

Figure 1 shows his gastroplasty as performed in 1971. It failed because of an overly large pouch and outlet stretching.

Gastric bypass became the vogue.

By about 1978 Cesar Gomez reported at this forum his technique of greater curvature horizontal gastroplasty. By then there was some appreciation that two rows of staples should be used, and the channel should be restricted in some way. He used a whip stitch of Prolene around the circumference of the channel as a form of restriction. This procedure rapidly became very popular. It was soon learned that the Prolene stitch could erode into the channel, break, and thus help produce an obstructed or dilated outlet. So, the failure rate again was too high.

After experiencing some of these failures with the Gomez gastroplasty, I thought Marlex mesh placed around the channel might be a better way to prevent its dilatation. I tried this in dogs.
Figure 2 shows a cross-section of Marlex mesh on a dog's stomach, the preserved layer of serosa completely overlying the muscular layer of the stomach, the right two-thirds of the stomach on the slide containing mesh or serosa (the vacuoles being the area of fallout of the synthetic mesh in a thin slide preparation) around the vacuoles, a layer or weave of fibroblasts, and finally a layer of neo-serosa covering the mound of fibrous tissue reaction. In short, a permanent fibrous band was created on the surface of the stomach with no erosion or damage to the wall of the stomach by the synthetic material.

I began doing the horizontal gastroplasty with a Marlex mesh band.

Figure 3 shows a diagram of the operation. Note the delicate stitch used to hold the Marlex in place. The three sutures on the greater curvature of the stomach represent a pexy to the parietal peritoneum to hold the upper stomach in place so that the pouch cannot fold over on itself at the staple line and obstruct the channel.
Figure 4 shows percent of excess weight lost over time for the first 33 patients. The weight loss pattern is good and repetitive and it can be concluded that the operation works.
Figure 5, however, demonstrates that when the same 33 patients are followed up two or more years, too many ultimately fail. Some of these patients underwent revision operations.

Figure 6 shows a diagram of the cross section of the channel showing no stretch of stomach wall beneath the mesh. Anchoring sutures of mesh are out on the wall of the channel. Staples making the boundary of the channel had disrupted and remain in one wall of the stomach, only. The solution to this was to take a deeper bite with the anchoring stitch through both walls of the stomach at the end of the staple line to promote scar tissue at this level.
Subsequent graphs plotting weight loss show only a slight decrease in the number of late weight gains.

Figure 7 shows a single staple line in mid-field pinching off mucosa and producing a barrier about 1-mm wide. This cannot be a very secure scar.

Figure 8 is at lower power and shows two areas of mucosa pinched off and in the center of the field a circle of mucosa with a horizontal
slit of preserved lumen (like pursed lips). This gives two 1-mm scars, but not much improvement.

Figure 9 is a diagram of two staple lines ending short of the greater curvature and one completely through-and-through stitch at the end of the staple line tied tightly enough to occlude the lumen between the staple lines.

Figure 10 is a higher power view of about one-half of the space between the staple lines. On the left is normal mucosa of stomach
outside of the staple line. The broad, dark band coming down from the
tip and up from the bottom and almost coming together before both turn
horizontally and extend to the right is muscularis mucosa of the two
walls of the stomach. Just where they turn horizontal is the staple.
The material between the horizontal lines is degenerating mucosa. It
shows subsequent collapse of this space formerly filled by mucosal cells.
The cystic areas represent residual areas of lumen. All of this debris
will be replaced by collagen fibers normally present on the mucosal side
of muscularis mucosa. The scar at the mucosal level is as wide as
separation of the two staple lines. It is presumed that mucosal cell
death occurs as continued secretion into the closed space lumen raises
pressure against the cell until secretory pressure of the cell is
exceeded.

The stronger resultant scar may stop the unzippering effect of the
staple line. The next technical change thus was to place a
through-and-through nylon suture at the end of the staple line, tie it,
and then apply the mesh again with the delicate tacking sutures.

Figure 11 again shows weight
loss in a group of patients who
mostly show good, uniform
results. However, there are
still failures.

One patient who failed under­
got gastroscopy and a wide
channel could be seen as in the
others. Additionally, the black
nylon suture was hanging down
from the anterior wall of the
channel, having pulled through
the posterior wall. The
unzippering effect of the
staples was again noted.
How to improve? By now there are at least 200 cases of horizontal gastroplasty in which Marlex has been the channel reinforcing material. There is not one documented case of perforation of the stomach or erosion of the mesh into stomach wall. The suture, however, does cut through stomach wall. Therefore, the through-and-through suture should perhaps be placed outside of the mesh. The mesh should keep the suture from cutting into the stomach wall.

Figure 12 shows the heavy suture placed outside of the mesh. The early results of this change were good. Then a patient four months postoperative returned, unable to keep down even liquids. Gastroscopy demonstrated a channel too small for even the pediatric gastroscope. At the channel orifice the mucosa on the medial staple-end side was markedly edematous, but the greater curvature mucosa was normal. Blocking most of the small channel was debris at first thought to be food but at surgery was found to be Marlex. At surgery the mesh could be sharply teased off the channel serosa everywhere except anteriorly and posteriorly where the through-and-through anchoring stitch had been placed. At these two points there was a perforating ulcer through which Marlex protruded into the stomach. The fibrous tissue and neo-serosa which had been laid down on the outer surface of the mesh prevented this from being a free perforation. Referring again to Figure 12, it seems apparent that these two ulcers beneath the suture resulted from pressure necrosis of the suture being tied too tightly.
By the time I discovered this first case, I had done several and as Figure 13 shows, a number of cases had to be reoperated. All had the same findings.

It is now into 1982 and Dr. Mason and Dr. Cornelius Doherty are collaborating on a vertical banded gastroplasty series with good early results.

Figure 14 shows the diagram of this operation. By making an opening with an EEA staple gun, one can suture to itself a precise length of Marlex with considerable uniformity of channel size and no trauma to the channel wall. This seemed a great improvement over what I was doing, so I adopted this technique on the horizontal gastroplasty. Also, it should invariably result in a broad mucosal scar between the staple lines.
Figure 15 demonstrates adoption of the EEA technique in an otherwise unchanged horizontal gastroplasty. Since June of 1982 I have been using this technique. One group of 47 patients had a 4.7-cm length of Marlex placed around their channels. This should give an internal lumen of 10 to 12 mm, depending upon whether the gastric wall is 1 or 2 mm in thickness. Of these patients, six had excessive vomiting. At gastroscopy, channel lumens of less than 9 mm were found. All were reoperated. Two others had additional surgery.

Again the successes remain as they have throughout the entire series, but secondary weight gain so far has been minimal.
Figure 16 shows the weight loss graph of a portion of this group.
The average response of a group allows comparison with another series. This is seen in Figure 17 in which my group is compared with those of Dr. Mason and Dr. Doherty in the same manner in which they study their own series. I have added an additional category which is the percent of all eligible patients in any given time period who were followed up. The mortality and morbidity of the three series are negligible. I believe Mason and Doherty have a slight edge in weight loss over my group, but the difference is small. I will concede the vertical banded gastroplasty is technically easier than the horizontal banded gastroplasty.

In spite of this I believe there are advantages to a horizontal banded gastroplasty.

Some ponderables to consider. A patient with a vertical banded gastroplasty was x-rayed in the standing position. A large swallow or two with barium was taken and three views of the stomach in rapid succession were taken. barium studies in two patients, one with vertical, the other with horizontal gastroplasty, showed more rapid emptying in the patient with a vertical pouch.

I believe that all of us have some patients who take only liquid or very soft foods which appear to pass more rapidly through the vertical pouch. Although Mason and Doherty have very good weight average losses,
it would not take too many of the liquid food eaters to significantly worsen their results.

Figure 18

We all want our patients to have a semblance of normal social life which often revolves around eating. Figure 18 shows specific post-operative eating habits. The higher the bar, the closer the eating lifestyle is to ideal or normal. The lower the bars, the more the surgery has changed the individual's lifestyle. The last bar on the right is percent follow-up.

Six of the 47 patients (12%) were reoperated owing to a too small channel for a satisfactory lifestyle. My solution was to increase the mesh measurement to 5-cm circumference rather than the 4.7-cm circumference. But what really constitutes a failure of the operation?--when the surgeon gives up and reoperates, making the channel larger, or when the patient gives up after repeated counseling and adopts a permanent liquid diet? Some patients in this latter group certainly must be considered just as much failures as the reoperated group. But they are not counted as such.

In conclusion, two points are stressed. One is that follow-up should be expressed as a percentage of those actually followed up compared to the entire number of the group for that time period being investigated. A patient followed up to a few months short of the time
being evaluated should not be counted. The second is that some form of lifestyle measurement in addition to the amount of weight lost is necessary for overall evaluation of the operative success.
A series of over 400 gastroplasties has been carried out, drawing on a previous experience with 105 gastric bypasses and, of course, the reported experience of others. The mechanisms involved in mechanical failures seemed apparent, and attention was focused on avoiding these as much as possible, without resorting to use of increased amounts of indwelling foreign material.

Since intact mucosal surfaces will not grow together, intentional cracking of the gastric surfaces has been induced by tightening the stapler as firmly as possible, and superimposing the two staple lines.

Reinforcement of the gastroplasty channel has been recognized as essential if failure of the procedure secondary to stomal dilatation is to be avoided. A single reinforcing suture has been used, anchored in the double staple line at least 1 cm from its distal end.
TISSUE REACTION AFTER SUBCUTANEOUS IMPLANTATION OF MARLEX AND DACRON MESH
Lars Granström, M.D., Lars Backman, M.D. and Sven Dahlgren, M.D.

Several different gastric procedures have been used as treatment for extreme obesity. Experience has shown that one main factor for good weight loss is a small patent outlet from the upper pouch. Several methods to create an outlet which cannot dilate have been tried, i.e. reinforcement with inverted running sutures and narrow bands. However, these reinforcements have a tendency to penetrate the gastric wall and disappear. In two of the latest methods, gastric banding and vertical banded gastroplasty, broader bands are therefore used as reinforcement to diminish the risk for penetration. The ideal reinforcement material is still to be found. It is possible that a too strong or a too weak tissue reaction may have negative side effects.

The aim of this study was to compare the subcutaneous tissue reaction to polypropylene (Marlex) and polyester (Dacron), two materials often used for reinforcement purposes in gastric surgery for obesity. Another aim was to describe our clinical experiences after using Marlex in 43 gastric bandings.

Tissue reactions to Marlex and Dacron in the subcutaneous fat were studied in 11 obese patients with a mean body weight of 120 kg. The mean Broca's index was 1.76 and the mean age was 32 years.

Small pieces of Marlex and Dacron were implanted subcutaneously in the left and right groin in a randomized way after local anesthesia. If Marlex was placed on the right side, Dacron was placed on the left and vice versa.

The small pieces of Marlex and Dacron were excised with the surrounding subcutaneous fat after eight weeks. The microscopic evaluation was done by a highly experienced pathologist who did not know the randomization result. The pathologist was to describe the fibrosis, the chronic inflammatory reaction and the foreign body giant cell reaction around the Marlex and Dacron patches (Table 1).
Table 1

Tissue reaction to Marlex and Dacron in the subcutaneous fat after 8 weeks (n=11)

<table>
<thead>
<tr>
<th></th>
<th>Fibrosis</th>
<th>Inflammatory reaction</th>
<th>Giant cell reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlex &gt; Dacron</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Marlex = Dacron</td>
<td>7</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Marlex &lt; Dacron</td>
<td>1</td>
<td>7</td>
<td>11</td>
</tr>
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There was no difference in fibrosis around the Marlex and Dacron patches. However, Dacron produced a stronger chronic inflammatory reaction and a stronger foreign body giant cell reaction. It is obvious that Marlex causes less reaction in the subcutaneous fat than Dacron. However, it is possible that the tissue reaction in the omentum and the stomach wall may differ from the reaction in the subcutaneous fat.

Eight of 44 patients have undergone reoperation owing to complications after gastric banding. Teflon (Gore-Tex) was used as reinforcement material in one of these patients. One patient was reoperated on because of penetration of the Marlex mesh. Another patient underwent reoperation because of kinking of the mesh site owing to adherence of the mesh to the liver. Six patients were reoperated on because of a combination of upper pouch dilatation and stenosis of the channel between the two pouches. Because of these reoperations, and also because of one death, we have been able to examine both the macroscopic reaction between the band and the stomach wall, and also the tissue reaction in the omentum which covered the band. Small pieces of the omentum were analysed by the same pathologist as in the study of the reaction in the subcutaneous fat. The pathologist was to grade the reaction in the omentum and the subcutaneous fat from 0 to 3+.
Tissue reaction to Marlex in the omentum (n=8) and in the subcutaneous fat (n=11) (0-3+)

<table>
<thead>
<tr>
<th></th>
<th>Fibrosis</th>
<th>Inflammatory reaction</th>
<th>Giant cell reaction</th>
</tr>
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<tbody>
<tr>
<td>Subcutaneous fat</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Omentum</td>
<td>+</td>
<td>+</td>
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Only one patient was examined both after subcutaneous implantation and in the omentum after reoperation, but there doesn't seem to be any major difference in the tissue reaction in the omentum compared to the reaction in subcutaneous fat.

The band material should produce enough tissue reaction to make the band adhere to the stomach wall, but not so much as to result in fibrosis and stenosis.

Our clinical experience after eight reoperations in 44 gastric bandings indicate that the tissue reaction between Marlex and the stomach wall is enough to adhere the Marlex band to the stomach wall. Although stenoses were seen more or less in six patients and penetration of the Marlex band in one patient, none of the reoperations were caused by a too strong tissue reaction to the Marlex band. Rather they were presumably caused by upper pouch dilatation and/or a band that was tightened too hard around the stomach.

Conclusion

This study demonstrates a strong chronic inflammatory and foreign body giant cell reaction against Dacron but not against Marlex in a group of extremely obese patients. This may indicate that Marlex is more suitable as reinforcement material in gastric surgery for obesity than Dacron. There may, however, be other materials which are even more suitable for the procedure than Marlex, i.e. Gore-Tex which we have tried or Silastic which has been tried by others.
RADIONUCLIDE MEASUREMENT OF GASTRIC EMPTYING AT ONE AND TWO YEARS
Cornelius Doherty, M.D.

In the postoperative study of the gastroplasty pouch, different methods make specific contributions. The radiological procedure using a mixture of barium and bran, as suggested by Dr. William Kridelbaugh, gives information on the integrity of the staple line, the size of the pouch, and whether the outlet is dilated or stenosed. Upper gastrointestinal fiberoptic endoscopy is valuable in evaluating reflux esophagitis, pouch gastritis, or ulceration, and also outlet obstruction. It specifically gives information regarding whether outlet obstruction is due to edema, foreign body or ulcer. Additional benefits of endoscopy are that it allows the removal of foreign bodies, and (using a pediatric 27F endoscope) it is possible to examine the remainder of the stomach, the pylorus and the proximal duodenum. Radionuclide gastric emptying studies are now well refined and can be applied to the evaluation of gastroplasty pouch emptying and gastric emptying. The solid phase study using technetium$^{99}$, sulfa colloid-labeled scrambled egg, requires minimal compromise of strict scientific standards and offers easy clinical application. Three groups have been studied: the first is a nonobese group of volunteers, the second is a prospective group of morbidly obese patients, and the third is a group of patients who underwent vertical banded gastroplasty 12- to 24-months prior to study. All patients fasted from midnight and were asked to abstain from cigarettes and chewing of gum. Any medications that would affect gastric motility were discontinued two days prior to the study. A scrambled egg labeled with 0.5 mc of technetium$^{99}$ sulfur colloid was prepared in a teflon skillet and eaten without delay. No fats were used, there was no taste to the isotopic tag, and the total radiation dose was less than that of a chest x-ray. The stomach was monitored for activity using a gamma scintillation camera with the patient in the supine position. Data was obtained immediately and at 15-minute intervals for 90 minutes. The patients were allowed to walk around between monitoring times. The data was recorded on a computer for quantitative analysis and it also was recorded on Polaroid film. The data was expressed as a fraction of the maximum gastric activity and also a half-time of emptying was calculated. The results of these calculations allow for radioactive decay and also were subjected to
both correlative and linear regression analyses. Gastric emptying in the normal nonobese volunteer subject is linear and its half-time is 44 minutes. The range of the half-time of gastric emptying is between 13 and 59 minutes.

The second group was composed of 35 morbidly obese patients who had not yet undergone vertical banded gastroplasty. Twenty-eight of these patients had essentially normal emptying patterns. One had a very rapid emptying pattern, one had a very delayed pattern, and five had borderline delayed patterns. Consequently we presume that on the basis of the preliminary data, there is no evidence of abnormality in gastric emptying as a cause of morbid obesity. The third group consisted of 25 patients who were at least 12 months post vertical banded gastroplasty. All their pouches had been measured at 30 ml or less volume at 50 cm of water pressure and their outlets had been banded with a 5.0-cm circumference of Marlex. Fifteen of these patients were actually more than 24 months postop and 10 were between 12 and 24 months. All the patients had a gastrointestinal radiological exam using the barium/bran preparation to confirm that the vertical partition was intact and that the banded outlet was not stenosed. In this group of patients the half-time of gastric emptying was 66 minutes. The range of the half-time of emptying was 9 minutes to >120 minutes. Of these patients, 60% had had good result with their vertical banded gastroplasty (greater than 60% excess weight loss). Forty percent of the patients had had a satisfactory result (between 40% and 60% of excess weight loss). There was no significant difference in the gastric emptying pattern observed at 12 and 24 months after vertical banded gastroplasty. There was a definite correlation between the half-time of gastric emptying and the percentage of excess weight loss.

The use of the radionuclide gastric emptying study in the postoperative vertical banded gastroplasty patient, when it is known that the vertical partition is intact and that the banded outlet is unchanged, will help us to further understand and treat symptoms of patients and possibly enhance their weight loss. A couple of examples that are brought to mind include a patient who, 18 months after vertical banded gastroplasty, had lost only 20% of excess weight. The vertical partition was intact, the outlet was unchanged, and this patient was known to be compliant in following her exercise program, her vitamin
supplementation and in abstaining from high-calorie liquids. However, the patient noted that she had never felt easy satiety. Accordingly, the radioisotope study was done and she was noted to have a very rapid emptying pattern. In fact, her half-time of emptying was nine minutes. I plan shortly to try her on a course of Pro-Banthine before her meals and see if this can decrease the rapid emptying or hyperperistalsis of her pouch musculature and hopefully provide her with a feeling of satiety and the possibility of losing more weight.

Another patient had sustained an 85% excess weight loss at 15 months after vertical banded gastroplasty. However, she repeatedly related that she felt gastric discomfort and nausea postprandially and occasionally would vomit four to six hours after eating. This patient was known to be compliant in every way in carrying out her exercise program, her vitamin supplementation and all of the recommended eating behavior modification. A radionuclide emptying study was obtained and she was noted to have a very prolonged emptying time. It was much greater than two hours. Accordingly, she was given 10 mg of metoclopramide 20 minutes before each meal, and she immediately noted relief of these symptoms. A follow-up emptying study was obtained after she began the metoclopramide and her half-time of emptying had decreased to 90 minutes. This improvement is speculated to be due to correction of the paresis in her pouch wall musculature.

In conclusion, this experience has demonstrated that the radionuclide gastric emptying studies are well tolerated and provide useful information for patient management.
NASOGASTRIC DRAINAGE: IS IT NECESSARY AFTER GASTROPLASTY?
Robert P. Zitsch, III, M.D. and Henry L. Laws, M.D.

Most surgeons employ nasogastric tube drainage after gastric surgery including gastroplasty for morbid obesity. In the past our practice was to utilize nasogastric (N.G.) tube drainage for two or three days following gastroplasty or gastric bypass. Beginning in June, 1982 we began to randomize all routine ring gastroplasty patients to (a) N.G. tube drainage for 48 hours, (b) no N.G. tube drainage. All patients were fully informed and agreed to enter the study which had been approved by our Institutional Review Board. Patients were assigned to groups by cards drawn in the Operating Room before abdominal closure. After 48 hours patients in both groups were begun on clear liquids. Patients were monitored for discomfort, vomiting, wound complications, and length of hospital stay. One hundred three patients were studied through April, 1983, of whom 61 received an N.G. tube and suction and 42 received no N.G. tube. No deaths, intra-abdominal abscesses, or gastric perforations were encountered in the study. Pulmonary complications were minimal in both groups. Length of hospital stay averaged 5.11 days with the N.G. tube and 4.88 with no tube. One patient had a wound dehiscence and six developed incisional hernias in the N.G. tube group. Patients without N.G. drainage developed no dehiscences and three incisional hernias. Patients not receiving N.G. tube drainage experienced much more comfortable postoperative courses. We have concluded that N.G. drainage is unnecessary after lesser curvature ring gastroplasty and no longer employ it. Since April, 1983 we have done an additional 54 gastroplasties without N.G. drainage with no resultant untoward effect.
A NEW NEEDLE FOR USE WITH THE EEA STAPLER

Richard F. Hearn, M.D.

Various surgical methods to help patients control the condition of morbid obesity have been used over the past sixteen years basically divided between gastroplasty and gastric bypass. At this meeting in 1981, Dr. Mason presented the technique of vertical banded gastroplasty. In May 1982 in Archives of Surgery he reported 40 cases and compared these results with other types of procedures including mortality, morbidity, reoperations for failure and concluded that this new procedure seemed to offer advantages over others.

The technique used in making the window portion of the operation consisted of using a portovac or hemovac needle and a red rubber catheter. In using this technique one of the problems we encountered was that the catheter either disengaged from the needle or the threaded end of the EEA instrument. This resulted in a hole in the posterior part of stomach which could not be found if the EEA did not follow the same tract as the needle puncture.

A new needle was developed that seems to offer several advantages over the previously described technique.

1. The needle is stainless steel, threaded inside and will not come off when the stomach is penetrated.
2. The needle comes in two sizes to accommodate different situations particularly length and thickness of the stomach.
3. Because it is tapered and thin, the needle does not split the stomach.
4. The needle fits disposable or permanent type EEA instruments.
5. The needle can be sterilized and used repeatedly.
6. The needle detaches easily from the EEA instrument with 2½ turns in a counter-clockwise direction.

Slides demonstrating the use of the new needle were shown at the meeting including a display.

Additional information may be obtained from the author.
TWO-STEP TREATMENT OF MORBID OBESITY

Teis Andersen, M.D., Ole G. Backer, M.D., Arne Astrup, M.D. and Flemming Quaade, M.D.

We believe that patients who have dieted and lost a large amount of weight should not be denied operative treatment because they no longer meet a preoperative weight criterion. On the contrary, we consider it an advantage that these patients have already demonstrated an important ability to comply with a diet, at least for a limited period of time. Patients with no history of successful dieting should on the other hand be considered probable failures after gastric intervention, as these operations do not at all make diet superfluous.

Secondly, although surgical risks can be reduced and have been reduced with increasing experience, they are still high simply owing to the obesity itself.

Thirdly, large numbers of lost kilograms - and 2.2 times larger numbers of lost pounds! - do not signify a sufficient weight reduction in patients who are initially as overweight as yours and mine.

Finally, we fight against the difficulty of making the patients understand that weight loss is not brought about by the operation in itself, but by the concomitant dietary energy restriction.

In a randomized clinical trial started in 1980, we compared the Gomez gastroplasty and an appropriate diet with a very-low-calorie formula diet as treatments of morbid obesity. As recently published in the New England Journal of Medicine, both treatments showed useful qualities but also important drawbacks. Both treatments led to immediate weight losses of about 25 kg. However, regain was different in the two patient groups. Weight regain after very-low-calorie diet was typically considerable and fast, while regain after gastroplasty levelled out after one year, leading to significantly better two-year results in the operated patients. Finally gastroplasty was associated with some well-known and unavoidable complications, while very-low-calorie diet proved completely safe.

Based on this experience we decided to combine the good elements of both treatments. We have chosen to continue to work with gastroplasty,
mainly because its simplicity and lack of gastrointestinal anastomoses has led to the lowest complication rate.

All patients in our series were more than 40 kg overweight and median body weight was 126 kg (range, 92 to 224 kg).

In the present series patients are pre-treated with very-low-calorie formula diet (VLCD). Gastroplasty is the second step, but operation is only offered if a 40% reduction of overweight is reached during VLCD. In this way, an adequate weight reduction is guaranteed and the operation made much easier and, no doubt, safer. Furthermore, the VLCD period offers an opportunity to make the patients understand that no easy way can safely bypass dietary energy restriction in the treatment of obesity.

Our very-low-calorie formula diet (388 Kcal) meets all recommendations and accordingly has proven extremely safe. The VLCD is run for repeated eight-week periods interrupted by two-week periods with a 900 Kcal conventional diet. The aim is primarily to reach the limit of acceptance for surgery, but most patients chose to continue far below this limit and we encourage them to do so.

Thirty to 45 patients are started on VLCD simultaneously and control is run at group-meetings. This means minimal time expenditure and low costs and the procedure is much appreciated by the patients. The group approach also makes possible a formalized education program. We deal with the fundamentals of energy metabolism, the relationships between nutrition and health, and we teach the patients to decode food declarations. The gastroplasty operation is explained, stressing its role as diet support, and the gastroplasty diet is taught in detail.

After having reached the greatest weight loss possible on VLCD, patients enter the queue for gastroplasty. Before surgery patients are randomly assigned to either gastroplasty as described by Dr. Gomez or to vertical banded gastroplasty as introduced by Dr. Mason. In the future this randomization will tell us which of the two operations to prefer with respect to complications and weight control when surgery is used for weight maintenance rather than for weight reduction.

Approximately 40% of the patients do not reach the arbitrary limit that we have chosen for surgery. In our terms they do not qualify for gastroplasty. On the other hand they avoid the increased surgical risks and the probable disappointment with the outcome. Of the remaining 60%,
most continue their preoperative weight loss far beyond the limit. A considerable number of the patients need VLCD for more than six months, a few are still in the VLCD program after 10 months.

Patients who were originally between 60 and 130% overweight have reduced to less than 75% (the median patient to 40%) at end of VLCD. While waiting for operation, patients lose a little more. The most obese patients are still losing, having until now lost 50 to 80 kg on VLCD. Two months after gastroplasty nearly all patients have left the high risk zone, most of them lying in the upper part of the normal weight range for height.

The study was not primarily designed to verify our expectation that surgery is safer in nonobese patients than in obese ones. That is every-day experience and has been verified by others.

In the present study we have found that gastroplasty helps patients keep their weight down. We feel it should only be performed in patients willing to comply with a diet. We believe that we are under an obligation to reduce the surgical risks to a minimum.
PRELIMINARY REPORT COMPARING GASTRIC BYPASS WITH GASTROPLASTY (added to program at the time of the meeting)

NYSLAND: We report a prospective series of 57 patients randomized to gastroplasty or gastric bypass. A horizontal double-stapled pouch with a measured volume of less than 50, usually 25 ml at a pressure of 50-70 cm water was used for both procedures. The stomas were identically made except that in gastric bypass no reinforcement was used. All patients were followed up for a minimum of six months and three-fourths of them were followed up for a year. From six months and on gastric bypass patients lost significantly more weight. Although there is a great difference in weight loss between these two groups of patients, there is no difference in stomal size. In the gastric bypass group there was no correlation between weight loss and stomal diameter. However, in the gastroplasty group there appears to be a relationship between stomal size and outcome of the operation. Patients with stomas greater than 15 mm all lost at least 30 kg except one. That patient, and those with stomas less than 15 mm lost more than 30 kg. Our results confirm that stomal size is of importance for the result of a gastroplasty procedure. There seems to be a threshold at stomal diameter of 15 mm. For the gastric bypass operation, however, the weight reduction correlates poorly with stomal size. Since the pouch sizes are the same for the two groups, there must be some other factor that influences the results of a gastric bypass operation. This could, of course, be some kind of humoral-neural factor, dumping, malabsorption, or something like that.
HERBST: We have a series of about 225 gastrogastrostomy patients from the University of North Carolina whom we have followed up for two years. The weight results are poor. Our excess weight loss at two years is about 40% compared to our Roux-en-Y gastric bypass group which is about 60-65% excess weight loss. It seems that the problem is the stretching of the stoma, much as Dr. Nysland demonstrated in his paper.

I was happy to hear the paper on the use of the nasogastric tube. A lot of us have been hesitant to remove the nasogastric tube and not quite had the courage to do it. I would like to ask why one group had so many more patients than the other (61 vs 42) if they were truly randomized?

ZITSCH: Although the numbers of patients appear unbalanced, they were truly randomized. We pulled cards for each patient to determine whether or not they were going to get a nasogastric tube.

KROYER: According to a show of hands, at least a third of those present routinely use a nasogastric tube.

FELDER: In 1976 I looked at the diagram of Dr. Mason's gastroplasty, and proceeded to band three patients with Marlex. I wasn't smart enough to realize that I should have done a pexy or that I should have covered the Marlex with omentum. Within two weeks I had to reoperate on all three patients for fantastic fibrosis, adherence to the liver, and twisting of the lower portion of the pouch on the upper pouch. I, of course, abandoned the procedure. There is enormous difference in reaction to this material from one patient to the next. I have operated unfortunately all too many times on people who have had large Marlex patches placed for abdominal wall defects. Sometimes everything is adherent to it, it's like going through concrete, and other times it's not bad at all and you can enter the abdomen without any trouble.

KROYER: I believe the thickness of the reaction to Marlex is dependent upon something other than placing it on the surface of the stomach. I can't help but feel that infection plays a role. Not every infection has to reach a clinical stage, it can be subclinical, it can be finally won over by the body, but the result is more granulation tissue leading to a thicker layer of scar tissue. Before I opened the stomach in any way and was just placing Marlex on its surface, I never saw much difference in reaction thickness, but when I began using the EEA to cut across the
mucosa causing some contamination, I began to see quite a variation in
the amount of fibrous tissue being laid down.

KFOURY: I feel that before you decide not to use the nasogastric tube
you should know that you are able to reintroduce it if necessary. Before
I discontinued the use of the nasogastric tube I asked my anesthesiolo­
gist to put the nasogastric tube in, pull it back, and push it in again.
With vertical banded gastroplasty it was easy to push it through because
the stoma lies in a straight line with the esophagus. I since have done
400 consecutive patients without the use of the nasogastric tube, and
none needed reintroduction of the tube in the postoperative period. When
adding other procedures to vertical banded gastroplasty, however, you
should continue to use the nasogastric tube.

QUESTION: Dr. Andersen, in your very low calorie diet do you give the
patients any essential fatty acids? With your extremely low carbohydrate
load, what happens to the level of ketones? Are you observing breakdown
in lean body muscle mass? So, are these patients really in better shape
for your surgery with that very low carbohydrate diet than perhaps a
little bit more reasonable diet?

ANDERSEN: There is in the formula diet sufficient amounts of the
essential fatty acids. Regarding ketosis, we have not measured that
quantitatively, only qualitatively. Some of the patients are ketotic for
a period and then it disappears. We are not concerned about it.

RUE: When an inadvertent stenosis develops or if the outlet is too
large, how does the panel recommend removing the Marlex?

KROYER: In my experience if one very carefully finds the plane beneath
the mesh, one can tease it off without any harm to the underlying
stomach.

COMMENT: When we reoperate we just cut the band and leave it.

KRAL: I am concerned about whether the patient really is in optimal
shape after having reduced a significant amount of weight. Studies, both
by Sarah Charles in Chicago and by Victoria Valley, have shown that
compliance with dietary intervention prior to operation will improve
postoperative results. I'd like to ask Dr. Andersen what he does with
the patients who will not and cannot cooperate with the program?

ANDERSEN: Regarding your concern, we make laboratory and ECD checks on
all our patients continuously during the treatment, and we have not found
untoward effects. Often the very low calorie diet is separated by one to three months from the surgical intervention. The patients we exclude from surgery have dietary advice. We do not feel it unethical to not operate on patients who we believe will not have a good result.
VERTICAL BANDED GASTROPLASTY
Edward E. Mason, M.D.

Gastric reduction for morbid obesity began with gastric bypass (GBP) in 1966 and has evolved to vertical banded gastroplasty (VBG) in response to lessons learned about the criteria that are important to success in safe weight control. VBG provides a meal-sizing segment along the lesser curvature which is separated from the remainder of the stomach by a stapled vertical partition and an outlet at the lower end of this segment that is reinforced by a Marlex mesh collar (Figure 1). Both pouch volume and collar circumference are carefully measured and this quality control not only increases the likelihood of success in weight control but allows an ongoing analysis of the relationship between operative measures and long-term results.

VBG was introduced in November, 1980, at the University of Iowa Hospitals and Clinics by Mason and in February, 1981, at St. Francis Memorial Hospital in San Francisco by Doherty. Through exchange visits we assured ourselves that the basic operative technique was the same at both institutions and the combined experience can now be reported for 533 patients operated on during the last three and one-half years. The patients referred to the University of Iowa Hospital averaged 20 kg heavier than those at St. Francis Hospital, but when patients are stratified by initial weight there is no difference in results at the two institutions.

VBG is a safer operation than any of the gastric reduction operations (GRO) with a horizontal staple line and a stoma within the staple line. Wound infection is now 1.9% compared to 14.5% to 18.3% with earlier procedures (Table I). In gastric bypasses done between 1966-1970 spleens were removed in 7.2% of patients. Only two spleens have been removed during 533 VBGs. Peritonitis from leaks has been reduced from over 4% to 0.6%. Operative mortality was 5.8% prior to 1970 with gastric bypass. This was reduced to 1.6% with horizontal gastroplasty, by earlier detection and treatment of perforations and to 0.7% with VBG.

There remains some risk with VBG since there can be injury to the esophagus, fundus and lesser curvature of the stomach and there can be failure of the stapled window and partition, but these risks are low as
is evident from the low leak and mortality rates. VBG requires less
dissection, no anastomoses and a shorter operative time than earlier
procedures.

Weight loss after operations for morbid obesity is always related to
initial weight, as well as to the operative procedure. Extremely heavy
patients are more aggressive in their consumption and even with the same
small food-sizing segment of stomach they level off at a higher weight
than patients whose initial weight was only twice or 100 pounds over
estimated ideal. Results must therefore be expressed separately for
heavier patients. Table II shows that mean percent excess weight loss
decreases as initial weight increases while absolute weight loss
increases.

Graphic analysis of raw data of weight change after various
operations can be studied in the type of plot shown in Figure 2, in
which percent ideal weight at two years is compared with percent ideal
weight before operation. In this plot a solid line represents complete
failure of the operation and the interrupted horizontal line shows a
two-year postoperative weight of 130% of ideal, a weight which provides
a normal risk for complications and mortality from obesity. The data
shown are those of 97 patients who have been followed up two years after
VBG5 (a 5-cm circumference Marlex mesh collar around the outlet). These
patients represent an 82% follow-up rate with revision in 2.3%.
Forty-seven percent reached a final weight of 130% or less but these were
patients whose initial weight was less than 225% of ideal. Heavier
patients lost even more in kilograms but leveled off at weights
significantly above what is considered a safe weight. On the basis of
Figure 2 the data were stratified into two groups using an initial weight
of 225% as the dividing line. Comparing these initially heavier and less
heavy patients, percent excess weight loss averaged 56±15 vs 70±21 and
weight loss in kilograms averaged 53±16 vs 39±13 (Table II).

Using regression analyses, comparisons were then made using the same
type of data shown in Figure 2. Regression analysis provides a single
line which best fits all of the points available for a given set of data.
Such analyses show that weight loss is greater for VBG5 than for VBG5.5
(5.5-cm circumference collar) (Figure 3), that VBG5 provides a better
weight loss than the horizontal gastroplasty used in 1978 and a much
better weight loss than the 1971 gastroplasty. There is no difference in the weight loss produced by VBG5 and RGB (gastric bypass with Roux-en-Y gastroenterostomy).

An important evaluation of any operation for treatment of obesity is the rate of reoperation, which is an objective measure of the failure rate of the procedure. Of course reoperation rate also depends upon the closeness of follow-up visits and the aggressiveness with which remedial operations are used. In our experience at University of Iowa Hospitals, VBG has had as low a reoperation rate as any procedure used to date, 1.1% per year. This could change as the years increase, but in our experience with less well-designed operations the higher rates have become evident during the first two years and tend to remain at a fairly constant rate for as long as ten years.

VBG5 is the most satisfactory GRO for obesity that we have found in 18 years of experience with these operations at the University of Iowa. It preserves the normal sequence of digestion and absorption since nothing is removed or bypassed. Though intended to be permanent it is reversible. Like all operations for obesity VBG5 does not bring patients whose initial weight is over 225% of ideal to the level of 130% of ideal weight and for such patients we are now using a 4.5-cm circumference collar. No data are yet available regarding the effects of the smaller collar.

At the first annual meeting of the American Society for Bariatric Surgery, held in June, 1984, a questionnaire regarding the types of GRO that are currently in use was collected. These data, when compared with the data from the 1982 and 1983 Bariatric Surgery Colloquiums, which were forerunners of this year's meeting, revealed several interesting trends. The percentage of surgeons performing gastric bypass has decreased from 33% in 1982 to only 22% in 1984, while gastroplasty as the operation of choice has increased from 67% to 78%. The version of gastroplasty that has shown the largest gain is vertical gastroplasty which is up from 46% in 1982 to 74% (Table III). From these figures it is apparent that vertical gastroplasty has become a popular operation with surgeons performing large numbers of GROs.

An important factor in obtaining good results with VBG5 is the measurement of the pouch volume, which only 61% of surgeons performing
VBG are doing. This may represent a step backward from the 71% that reported measuring pouch volume in 1983. An encouraging note is that, of those who measure volume, 68% are using a known distending pressure to control the measurement and to ensure an accurate and consistent pouch volume in their patients. Results from the first three and one-half years use of VBG5 have been excellent in terms of safety and effectiveness. If the low mortality, low morbidity and high effectiveness are to be maintained, the operation must be performed to specifications that have been developed over the years.

Figure 1 shows the window that is stapled with the center removed so that the partition is separated from the stoma by a short segment of divided stomach and so that the Marlex mesh can be sewn to itself and not to the stomach.
Figure 2 shows percent ideal weight at two years and before operation for each of 97 patients. The solid slanting line represents failure to lose. Anything below the transverse dotted line would be generally considered as a complete success. Stratification into two groups at 225% ideal preoperative weight would seem to fit the data better than the three groups separated by vertical interrupted lines.
Figure 3 shows a regression line for the data provided in Figure 2 and another regression line for VBG5.5. Collar circumference of 5 cm causes more weight loss than 5.5 cm.
TABLE I: Complications from selected gastric reduction operations performed at the University of Iowa Hospitals as compared to Vertical Banded Gastroplasty.

<table>
<thead>
<tr>
<th></th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GASTRIC</td>
<td>GASTROPLASTY</td>
</tr>
<tr>
<td></td>
<td>BYPASS</td>
<td>'Gomez'</td>
</tr>
<tr>
<td># of Patients</td>
<td>69</td>
<td>73</td>
</tr>
<tr>
<td>Wound Infection (%)</td>
<td>14.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Splenectomy (%)</td>
<td>7.2</td>
<td>1.4</td>
</tr>
<tr>
<td>GI Leak (%)</td>
<td>4.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Mean Operative Length (minutes)</td>
<td>305±73</td>
<td>163±40</td>
</tr>
<tr>
<td>Operative Mortality (%)</td>
<td>5.8</td>
<td>0.0</td>
</tr>
</tbody>
</table>
TABLE II: Patients followed up at least two years with VBG5, stratified into either three or two groups, according to initial weight. The 97 patients shown represent an 82% follow-up rate.

<table>
<thead>
<tr>
<th></th>
<th>&lt;200</th>
<th>200-250%</th>
<th>&gt;250</th>
<th>&lt;225</th>
<th>&gt;225</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># of Patients</strong></td>
<td>46</td>
<td>42</td>
<td>9</td>
<td>68</td>
<td>29</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>112±10</td>
<td>141±16</td>
<td>174±22</td>
<td>118±13</td>
<td>159±20</td>
</tr>
<tr>
<td>2 years</td>
<td>77±12</td>
<td>93±18</td>
<td>112±20</td>
<td>79±13</td>
<td>106±19</td>
</tr>
<tr>
<td><strong>% Ideal Weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>182±10</td>
<td>222±16</td>
<td>275±28</td>
<td>191±15</td>
<td>249±24</td>
</tr>
<tr>
<td>2 years</td>
<td>124±17</td>
<td>146±25</td>
<td>178±18</td>
<td>127±19</td>
<td>166±26</td>
</tr>
<tr>
<td><strong>Excess Weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop (kg)</td>
<td>50±7</td>
<td>77±12</td>
<td>111±18</td>
<td>56±10</td>
<td>95±16</td>
</tr>
<tr>
<td><strong>% Excess Weight Loss</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years</td>
<td>77±22</td>
<td>63±18</td>
<td>56±16</td>
<td>70±21</td>
<td>56±15</td>
</tr>
<tr>
<td><strong>Weight Loss</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Years (kg)</td>
<td>35±11</td>
<td>48±16</td>
<td>62±18</td>
<td>39±13</td>
<td>53±16</td>
</tr>
</tbody>
</table>

TABLE III: Type of procedures being performed by surgeons replying to questionnaires distributed during last three years at an annual meeting held in Iowa City to discuss surgical treatment of obesity.

<table>
<thead>
<tr>
<th></th>
<th>1982</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of surgeons</td>
<td>138</td>
<td>149</td>
<td>127</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Procedure Performed</th>
<th>1982</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric Bypass</td>
<td>33</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Vertical Gastroplasty</td>
<td>46</td>
<td>66</td>
<td>74</td>
</tr>
</tbody>
</table>
VERTICAL ROUX-EN-Y VS VERTICAL BANDED GASTROPLASTY
Harvey J. Sugerman, M.D., Janet V. Starkey, R.D., and Charles R. Blocher, B.S.

Patients were randomly assigned to either a vertical Roux-en-Y gastric bypass (GBP) - 20 patients - or vertical banded gastroplasty (VBGP) - 20 patients. The two groups were comparable with regard to age, sex, ideal body weight and preoperative weight. Based on preoperative dietary interview, the patients were classified according to eating habits as nibbler (N)/gorger (G) or sweets (S)/non-sweets (NS) eaters. The operative procedures were compared to each other regarding morbidity and weight loss and subdivided according to eating habit. One patient (478 lbs) without preoperative respiratory insufficiency, had a GBP and died suddenly on the fifth postoperative day (autopsy failed to reveal a cause). One patient with VBGP was lost to follow-up. A significantly greater weight loss was noted after GBP than VBGP (Table 1) at all time intervals. There was no difference between N or G within or between groups. There also was no difference between S or NS after GBP. However, the NS had a significantly (p<0.05) greater percent excess weight loss than the S eater at 12 months after VBGP (65 ± 16 vs. 40 ± 13). GBP patients had a significantly (p < 0.01) lower Vitamin B₁₂ (260 ± 157 vs. 417 ± 130) than VBGP at 12 months. No significant differences were noted for hemoglobin, albumin or thiamine. GBP was associated with a significantly better weight loss, which was probably due to patient intolerance to sweets as a result of the dumping syndrome. However, this was at the expense of an increased risk of Vitamin B₁₂ deficiency.

Table 1. Percent Decrease in Excess Weight (N)

<table>
<thead>
<tr>
<th></th>
<th>3 months</th>
<th>6 months</th>
<th>9 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBP</td>
<td>37 ± 9 (19)</td>
<td>53 ± 10 (19)*</td>
<td>70 ± 25 (16)*</td>
<td>70 ± 15 (13)**</td>
</tr>
<tr>
<td>VBGP</td>
<td>30 ± 12 (19)</td>
<td>39 ± 15 (19)</td>
<td>42 ± 18 (17)</td>
<td>49 ± 20 (10)</td>
</tr>
</tbody>
</table>

* p < 0.01 ** p < 0.05
VERTICAL GASTROPLASTY WITH CHROMIC OR SILASTIC RING VS GASTRIC BYPASS
Gifford V. Eckhout, M.D.

In 1979, in an attempt to develop an operation for morbid obesity which would be safer than gastric bypass and still produce satisfactory long-term weight loss, we began a study of vertical gastroplasty (VG), as described by Fabito.\(^1\) Several changes in technique have evolved as we have gained experience with the operation.

This report concerns a study of 387 vertical gastroplasty patients compared with 85 gastric bypass (GB) patients using a loop gastrojejunostomy with a single staple line.\(^2\)

SUBJECTS AND METHODS

The VG group includes 192 patients with a chromic ring-supported lesser curvature stoma, 157 patients with a covered, buried silastic ring-supported lesser curvature stoma, and a third group of 38 patients with an uncovered, nonburied silastic ring-supported lesser curvature stoma.

In VG, a modified TA 90,\(^3\) with a notch at the heel to allow for the stoma, is applied twice for a double staple line, which is then reinforced with a 2-0 prolene.

In the first 192 patients, a #1 chromic was tied over a 30F dilator in the lesser curvature channel to stabilize the stoma. A pseudopylorus was made with running 2-0 prolene, and a layer of silk lemberts to accentuate the pseudopylorus.

The second group of 157 VG patients had a 40-mm silastic ring, size 7F fashioned to support the stoma following Henry Laws' technique.\(^4\) The stomach wall was also turned in, to create a pseudopylorus and cover the silastic ring. Because of a 7% incidence of silastic ring erosion with a covered ring, the third group of 38 VG patients was done with the same technique, except that a 43-mm silastic ring was used which was not buried and was left uncovered. All patients had a gastrographin UGI at 24 hours after operation to confirm the anatomical result of the procedure and to rule out leaks. All VG patients were on a full liquid diet for three months.
COMPLICATIONS

There were no cases of peritonitis or abdominal abscess. There was one death due to coronary artery disease (Table 1). Staple line failure occurred in 17.4% of the GB group and 2% of the VG patients.

Stomal dilation occurred in 10.9% of the VG patients with the chromic ring, resulting in weight gain and requiring revision. Stomal dilation was not a problem in the covered silastic ring VG patients unless the silastic ring eroded into the lumen, which occurred in 11 patients. Eight of the 11 patients have been revised because of weight gain. The other three are not gaining weight and are asymptomatic.

The revision rate was 25.9% for GB, mainly for staple line failure and bile gastritis. The revision rate was 13.5% for chromic ring VG patients, mainly for stomal or pouch dilation. The revision rate was 5.1% for covered silastic ring VG patients for erosion of the silastic ring patients.

Rehospitalization for vomiting has been necessary in 7% of chromic and covered silastic ring patients. None of these patients were obstructed at the time of barium swallow and only 2% required dilations. No dilations or rehospitalizations were required for uncovered silastic ring patients.

RESULTS

The percent of excess weight lost at 12 months after operation was 63.5% for GB, 56.7 for VG with the chromic ring and 62.0 for VG with the covered silastic ring (Table 2). The percent of excess weight loss at 24 months was 70.3, 50.6 and 60.8 respectively. The percent of preoperative weight lost at 12 months was 32.1 for GB, 29.2 for VG with the chromic ring and 32.0 with the covered silastic ring. The percent of preoperative weight lost at 24 months was 35.5, 25.5 and 31.3 respectively.

Follow-up study regarding weight loss for the uncovered silastic ring patients is too short to be meaningful in this series; however, the weight loss is 25% and 29.3% of preoperative weight lost at six months and 10 months respectively.

Other surgeons \textsuperscript{4,5,6,7,8,9,10,11} who have been using the silastic ring YG for up to four years report satisfactory weight loss (Table 3). We have collected a series of 2515 silastic ring VG patients. There are 1014 covered silastic rings and 1501 uncovered silastic rings in the
series. At 12 months, the weight loss varies between 28% and 36% for covered silastic ring patients and between 33% and 36% for uncovered silastic ring patients. At 24 months, weight loss increases to 31% to 39% for covered rings and 33% to 38% for uncovered silastic rings. Alston reports the percent of excess weight lost at 12 months as 68%, and 70% at 24 months for uncovered rings.

COMMENT

VG with a silastic ring is producing weight loss at 24 months which is comparable to gastric bypass. Patient satisfaction is also equally good. All patients are followed up by the author and 90% handle solid foods, including meat, without difficulty and without vomiting. Patients with the uncovered silastic ring have even less difficulty and less vomiting than the covered silastic ring patients. In addition, VG avoids the known problems of gastric bypass, such as vitamin deficiency, anemia, marginal ulcer and inability to examine the bypassed stomach.

However, in the group of 157 covered buried silastic ring patients, we have seen 11 silastic ring erosions with up to two years follow-up study. It is postulated that the cause of silastic ring erosion is due to pressure on the ring caused by sutures that are too taut, which are used to turn in the gastric wall to form the pseudopylorus. If sutures are taken too close to the silastic ring, tension is placed on the gastric wall as the silastic ring is covered causing pressure on the ring, resulting in erosion.

On the other hand, if the ring is left loose on the gastric wall, there is no pressure in any direction to cause erosion. The theory of pressure on the ring causing erosion appears valid as shown in the collected series of 2515 patients who underwent vertical gastroplasty with silastic ring placement (Table 4). Of 1014 covered silastic rings in the series, there were 29 erosions of the silastic ring for an incidence of 3%. Of 1501 uncovered silastic rings in the series, there was only one erosion. This single erosion occurred in a 550 pound man who persisted in eating steaks and all solid foods immediately after leaving the hospital and tore out his ring in three months. Consequently, it appears if the silastic ring is not buried, the incidence of erosion approaches zero.
CONCLUSION

VG with an uncovered silastic ring-supported stoma is an operation for morbid obesity which is simple and reversible. It avoids any anastomosis or resections of gastric wall, with resultant staple or sutures lines that are more prone to leak than are simple staple lines in the stomach.

It has a low complication and low revision rate and provides satisfactory weight loss at 24 months. It has a standardized stoma, which is reproducible and contributes to more uniform weight loss in different hands. It also avoids the use of any large foreign body on the stomach, which may migrate and cause obstruction at a later date. Patient satisfaction is comparable to gastric bypass. The known complications of gastric bypass are also avoided. If weight loss continues to be sustained after two years, and silastic ring erosion is prevented by leaving the ring uncovered as appears to be the case at this time, then silastic ring vertical gastroplasty is a safer more physiologic operation for morbid obesity than gastric bypass.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
</table>

 MORBID OBESITY - ECKHOUT  
Surgical Complications

<table>
<thead>
<tr>
<th>GB</th>
<th>VSG-CHROMIC</th>
<th>VSG-SILASTIC RING</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB</td>
<td>VSG-CHROMIC</td>
<td>VSG-SILASTIC RING</td>
</tr>
<tr>
<td>85 Pt</td>
<td>192 Pt</td>
<td>Cov 157 Pt</td>
</tr>
<tr>
<td>Deaths</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Staple Line Failure</td>
<td>17.4%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Stomal Dilation</td>
<td>0%</td>
<td>10.9%</td>
</tr>
<tr>
<td>Bile Gastritis</td>
<td>9.4%</td>
<td>0%</td>
</tr>
<tr>
<td>Erosion of Silastic Ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td>25.9%</td>
<td>13.5%</td>
</tr>
<tr>
<td>Splenectomy</td>
<td>9.4%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Wound Infection</td>
<td>12.9%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Rehospitalized-Vomiting</td>
<td>1.2%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Stomal Obst.-dilated</td>
<td>0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Acute Dist. Gast. Dil.</td>
<td>1.2%</td>
<td>0%</td>
</tr>
<tr>
<td>Gastric Hemorrhage</td>
<td>1.2%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Afferent Loop Obst.</td>
<td>1.2%</td>
<td>0%</td>
</tr>
<tr>
<td>Pulmonary Embolus</td>
<td>2.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Leaks</td>
<td>0%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Marginal Ulcer</td>
<td>2.3%</td>
<td>0%</td>
</tr>
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### TABLE 2

**MORBID OBESITY - ECKHOUT**

Comparison of Average Weight Loss

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Pounds</th>
<th>% Excess Wt. Loss</th>
<th>% Preop Wt. Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric Bypass (85 Pts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Mos. - 74 pts</td>
<td>80.4</td>
<td>63.5</td>
<td>32.1</td>
</tr>
<tr>
<td>24 Mos. - 32 pts</td>
<td>87.6</td>
<td>70.3</td>
<td>35.5</td>
</tr>
<tr>
<td>Vert. Stapled Gastroplasty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromic Ring (192 Pts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Mos. - 102 pts</td>
<td>77.9</td>
<td>56.7</td>
<td>29.2</td>
</tr>
<tr>
<td>24 Mos. - 72 pts</td>
<td>67.4</td>
<td>50.6</td>
<td>25.5</td>
</tr>
<tr>
<td>Vert. Stapled Gastroplasty - Silastic Ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covered Ring (157 Pts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Mos. - 109 pts</td>
<td>83.1</td>
<td>62.0</td>
<td>32.0</td>
</tr>
<tr>
<td>24 Mos. - 39 pts</td>
<td>78.8</td>
<td>60.8</td>
<td>31.3</td>
</tr>
<tr>
<td>Uncovered Ring ( 38 Pts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Mos. - 14 pts</td>
<td>68.3</td>
<td>46.6</td>
<td>25.0</td>
</tr>
<tr>
<td>8-11 Mos. - 5 pts</td>
<td>84.6</td>
<td>49.4</td>
<td>29.3</td>
</tr>
</tbody>
</table>

### TABLE 3

**COLLECTED SERIES - ECKHOUT**

VERTICAL GASTROPLASTY - 2515 PATIENTS
1014 COVERED AND 1501 UNCOVERED SILASTIC RINGS

% of Weight Loss

<table>
<thead>
<tr>
<th>Procedure</th>
<th>12 Mos Cov./Uncov</th>
<th>24 Mos Cov./Uncov</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eckhout</td>
<td>32%/-</td>
<td>31%/-</td>
</tr>
<tr>
<td>Fox</td>
<td>35%/34%</td>
<td>35%/</td>
</tr>
<tr>
<td>Willbanks</td>
<td>—/-</td>
<td>36%/36%</td>
</tr>
<tr>
<td>Fabito</td>
<td>34%/36%</td>
<td>36%/37%</td>
</tr>
<tr>
<td>Kane</td>
<td>—/-36%</td>
<td>—/-38%</td>
</tr>
<tr>
<td>Laws</td>
<td>28%/</td>
<td>33%/</td>
</tr>
<tr>
<td>Shamblin, J.</td>
<td>36%/</td>
<td>39%/</td>
</tr>
<tr>
<td>Shamblin, W.</td>
<td>33%/33%</td>
<td>33%/33%</td>
</tr>
<tr>
<td>Alston (Excess Wt. Loss)</td>
<td>—/-68%</td>
<td>—/-70%</td>
</tr>
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TABLE 4

COLLECTED SERIES - ECKHOUT
VERTICAL GASTROPLASTY - 2515 PATIENTS
1014 COVERED AND 1501 UNCOVERED SILASTIC RINGS
NUMBER OF RING EROSIONS

<table>
<thead>
<tr>
<th></th>
<th>Cov./Eros.</th>
<th>Uncov./Eros.</th>
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<tbody>
<tr>
<td>Eckhout</td>
<td>157/11</td>
<td>38/0</td>
</tr>
<tr>
<td>Fox</td>
<td>139/1</td>
<td>46/1</td>
</tr>
<tr>
<td>Willbanks</td>
<td>150/0</td>
<td>501/0</td>
</tr>
<tr>
<td>Fabito</td>
<td>40/4</td>
<td>100/0</td>
</tr>
<tr>
<td>Kane</td>
<td>0</td>
<td>270/0</td>
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<td>Laws</td>
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<td>76/0</td>
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<td>15/0</td>
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<td>Total</td>
<td>1014/29</td>
<td>1501/1</td>
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REFERENCES
1. Fabito D. Personal communication.
3. Fabito D. Personal communication.
5. Willbanks O. Personal communication.
6. Fabito D. Personal communication.
7. Alston J. Personal communication.
8. Kane J. Personal communication.
9. Fox S. Personal communication.
11. Shamblin W. Personal communication.
DIVIDED VERSUS STAPLED POUCH IN VERTICAL BANDED GASTROPLASTY
J. E. Arata, M.D. and A. J. Perry, M.D.

A questionnaire taken during the 1983 Bariatric Surgical Colloquium disclosed 112 surgeons to be performing gastrop1asty and 37 were doing gastric bypass. Of those doing gastrop1asty, 98 were performing vertical gastrop1asty, three were performing a gastrogastrostomy, and 11 were performing horizontal gastrop1asty. Of great interest to me at this time was the fact that 103 out of 109 were stapling in continuity while six surgeons had decided to carry out divided gastrop1asty.

At this same conference, a number of surgeons noted that they had had failures in the banded gastrop1asty due to a breakdown with the vertical line.

No one seems to know the incidence of the breakdown of the vertical line, but one would expect this to be an occasional occurrence judging from our previous experiences with the "stapling-in-continuity" of the stomach in previous transverse gastrop1asty. This has been noted by gastroscopists and also by surgeons studying the reasons for failures.

In the past year, I've been able to confirm that three of our vertical gastrop1asties have had a failure of the vertical line. This stimulated my interest, and I felt the obvious solution would be to carry out a vertical divided gastrop1asty.

I feel very humble in studying such a small portion of the Mason procedure because our experience with the conventional procedure has been so good, and the mortality and morbidity has been so little that one must approach any modification with great trepidation. I felt that this deserved a report.

SYMPTOMS

I have suspected a breakdown of the vertical line when a person who normally was losing weight would then stop losing and would indicate that they could eat a great deal of food more rapidly than before.

I tried various x-ray techniques to show this, but at no time was I able to satisfy myself that the radiological techniques were of much benefit. The barium would not be obstructed at the stoma, and so when one saw barium in the fundal pouch, one could not be certain it had not refluxed from the stomach distal to the stoma.
With the suspicion of this occurrence, I instructed our endoscopist to look for this; and he was, indeed, able to show this on three occasions. Without warning him of it, he states that it is very easy to miss an opening near the top of the pouch.

At surgery, it is very easy to demonstrate this by occluding the esophagogastric juncture with a Penrose drain and placing a Foley catheter through a gastrotomy into the vertical pouch and then filling it with water or saline under mild pressure. One is unable to contain the pressures, and the problem is obvious.

This past year, I carried out vertical divided gastroplasty while my partner continued carrying out vertical banded undivided gastroplasty.

Our report is of necessity somewhat preliminary since I have done this only during the past year.

The technique that I have used has been to carry out the necessary steps up to the completion of the buttonhole into the stomach with the EEA stapling device. Following this, I use two TA-90 stapling devices and have applied them so that there is approximately a half-inch separation from the one along the long narrow pouch as opposed to the one along the fundal pouch. After these two have been placed and fired, two more are applied medially and laterally to the prior two firings. I thus end up with four staple lines, and I have then divided this with a number of methods. At first, I merely divided and attempted to pick up the bleeders along the edge of the divided stomach. When this became somewhat of a problem, later I attempted to use fulguration. Most recently, I have left the clamps on and have used a locking suture of 3-0 chromic catgut. I have felt that the problems with the divided gastroplasty stem chiefly from the poor control of the bleeding at this difficult stage of the operation. Exposure in the left upper quadrant in an extremely obese patient is never easy, and I have felt this is probably the greatest problem that we have had.

In my series of patients, there were three abscesses, two of which were major complications. In one of these cases, there was a leak from the fundal pouch that had been divided. In the other, we were unable to find any leak. Each of these patients was in the hospital for an extended period of time, and the use of a respirator was necessary. Fortunately, there was no mortality in my series. My partner did not
measure the stoma internally and did not divide his pouches. His incidence of intra-abdominal abscess was zero.

We then attempted to compare the weight loss of the one procedure versus the other. Our study times and our numbers were not significant to arrive at any conclusions but merely to arrive at impressions.

In a previous study in which neither of us divided the stoma but in which I measured the stomal outlet, my patients were somewhat happier than my partner's patients, but their weight loss was less. Our techniques varied in that the pouch sizes were essentially the same although his stomal diameters were probably 1-mm to 2-mm less.

There's a suggestion in our preliminary figures that my weight losses are now somewhat greater than my partner's weight losses, but this will need to be studied for a longer period of time.

If one is to prevent the breakdown of the vertical line in all cases, some study must be given as to the cause of the breakdown. It is hard to fathom why a double stapling does not always prevent this breakdown. A divided line ought to prevent this complication.

I believe the only way to arrive at the incidence of this complication would be to perform gastroscopy in 100 patients consecutively at a significant period of time after the gastroplasty. I am doubtful that this can be done in our particular setting. I have also considered devising a catheter with a balloon that would be placed into the stomach, and the catheter inserted and pulled back against the stoma. A swallow of barium then might tell us whether there is any leakage of barium from the vertical pouch into the remainder of the stomach. I have not followed this further for I'm afraid that the cooperation with our radiologist might be less than would be necessary to carry this out on a significant number of people.

I would suggest, if one decides to carry out a divided gastroplasty, that great attention be paid to hemostasis of the divided portions of the stomach. I believe this can be done technically if one will oversew the edges with fine chromic catgut prior to removal of the TA-90 staple gun. I would not recommend the use of a GIA stapling device which would only leave two rows of staples on either side of the divided area. Early in my work, I attempted to use the GIA stapling device, and I found it clumsy. Also one person had a leak, probably due to a technical failure.
I will continue to carry out this procedure carefully, and hopefully I will be able to have some significant figures on the weight loss of these patients after a year, and perhaps the morbidity of intra-abdominal abscesses can be cut down with a better technique.
MASON: I'm going to take the liberty of adding a paper. Dr. Clemmesen from Copenhagen will tell you about a modification of vertical banded gastroplasty. Actually, he's from Hillerod but that's near Copenhagen.

CLEMMESEN: Talk added to original program

Most of us can agree that it is the patients who will not comply that give us the trouble and the failures in bariatric surgery. It is therefore my belief that our method of operation should be prepared for these noncooperative patients. I believe the operative failures in these patients who continue to eat too much are due to three things: (1) If the greater curvature of the stomach is a part of the pouch it will dilate, making the pouch too big and allowing the patient to eat too much at a time. (2) If the outlet of the pouch is not secured it will dilate, allowing the patient to eat too often. (3) If the staple line in the pouch is holding only mucosa to mucosa, it will give way even when oversewn. Therefore, it is necessary to divide between the staple lines, just as Dr. Arata has said. From this belief or theoretical basis I have made a modification of Dr. Mason's vertical banded gastroplasty.

I divide between the two staple lines. Then I oversew the staple line on the pouch side because I do not dare rely on one staple line. I put the band around the outlet with a 1-cm diameter tube inside and I take great care when I make the Mason opening to calibrate with that and not with my mesh. I put it loosely around so it won't dilate later on. I take the oversewn staple line and the staple line along the fundus and lift them up so I can see the back wall of the fundus and the back wall of the pouch and then I make sutures so that the fundus is folded around the pouch. My approach to the smaller sac is through the greater omentum. Then, lifting up the stomach, it's very easy to put in the last sutures so it's closed completely on the back side. I do the same procedure on the front, folding the fundus around the pouch similar to a "half Nissen fundoplication." When finished, the staple lines are closed completely, and the pouch lies inside the fundus. That way the pouch wall is two layers of stomach.

The results of this operation are preliminary as I have only used it for 11 months and on 28 patients. There has been no dilatation of the pouch or the outlet and no breakdown of the staple line, and all patients are still losing weight.
GRaves: (Herschel Graves, Nashville.) I would like to support Dr. Eckhout's method of preventing staple line disruptions by simply oversewing the staple line with continuous 2-0 Prolene. I've had no disruptions that I know of using this method.

When I began doing gastric bypasses I measured the volume of three or four pouches and found that they averaged 20 ml. I was making the pouch as small as I could make it no matter what the volume showed. Now that I am doing the vertical banded gastroplasty, I place the TA90 as snugly against my esophageal dilator as possible and I'm making the pouch as small as I can make it no matter what the pouch measurement would show. I have heard reports at this meeting of mortality and morbidity owing to esophageal mobilization which I presume is being done to measure the pouch volume. If this continues we may be condemning future patients to morbidity and mortality just to measure the pouch. Wouldn't it be better to make it as small as possible without measuring it?

Mason: You have asked an excellent question, for which I can answer only that you may be right. The reward must justify the risk.

Kfoury: (Emil Kfoury, Baltimore.) This is similar to problems with disruption of the two parallel staple lines. After hearing Dr. Printen's paper in 1981 showing no necrosis between the staple lines, I started using three lines. I have done about 300 cases with three parallel applications without any necrosis at all, but I still have had at least one demonstrated disruption despite the three applications. There has been no harm from applying the stapler three times. I use the old-fashioned, nondisposable, TA95 stapler which I put in from the angle of His down to the window. After I fire my first application I open the stapler, take the used cartridge out and feed in a new one, fire it, and repeat the process. Then I remove the stapler.

Herbst: (Charles Herbst, Chapel Hill.) Dr. Mason, if I understood correctly, your reoperation rate for vertical banded gastroplasty was about 1% per year for the first two years. By the third year it had gone up another 4%. Could you comment on that and tell us what were the indications for reoperation in these patients?

Mason: The reoperations were in the earlier group of patients. There were 12 reoperations, seven of them for staple failure, one for
obstruction, and four were patients who for one reason or another had the operation taken down and abandoned.

FELDER: (Martin Felder, Providence.) Dr. Mason mentioned that the vertical banded gastroplasty is an antireflux procedure. In patients with symptomatic hiatal hernias does the panel recommend anything other than the vertical banded gastroplasty? Should one attempt to return the stomach to the abdominal cavity?

MASON: Your first question was with regard to reflux, do you do anything special about the patient who has reflux symptoms preoperatively?

SUGERMAN: We don't do anything special, and most of these patients will have a significant improvement in their reflux symptoms after surgery regardless of the procedure used. I must admit this surprises me because I can't figure out how it's an antireflux procedure even though Collis described it as such. There have been some reports of patients who have developed fairly severe reflux esophagitis after vertical banded gastroplasty.

MASON: I believe that if the partition is close to the lesser curvature and at the angle, vertical banded gastroplasty will be an antireflux procedure. You can test this, if you want to, by filling the stomach up with saline, pulling the Ewald tube up into the esophagus and putting pressure on the stomach and see if it refluxes. This test was described by Dr. Siroos Shirazi in our department a few years ago. I admit that the Collis gastroplasty is not one of the best antireflux procedures, but so far I have been happy with it. I know that a few of the patients do have some heartburn early. Most of those patients get over that fairly quickly, and I think it's due to edema of the outlet. Once that subsides they seem to be all right.

HALVERSON: (John Halverson, St. Louis.) Have you actually quantified the number of dumping symptoms your patients have had?

SUGERMAN: It's very difficult to objectively quantify dumping symptoms in either group of patients. Most of the patients who had the Roux-en-Y gastric bypass didn't have dumping symptoms, they merely stated that they lost their interest in eating sweets. They didn't say why, they just said they just didn't have the taste for sweets any more. We would like to get more objective data between the two groups of patients with
particular reference to measuring serotonin levels as well as glucose tolerance curves. When I began my study, I was hoping the two series would come out the same. I would then have been in favor of doing the vertical banded procedure because I think it will be associated with fewer long-term complications. However, the less optimal weight loss results with vertical banded gastroplasty motivate me to try to preselect the patients as to which one will do best with a given procedure.
INFLUENCE OF ORAL PROPHYLACTIC ANTIBIOTICS ON GASTRIC FLORA

J. E. Arata, M.D. and A. J. Perry, M.D.

In 1983, at the Bariatric Surgery Colloquium, we discussed the bacterial status of the stomach before and after the introduction of oral gastric tubes. It was our conclusion that gastric cultures taken through a gastrostomy prior to intubation indicate the stomach is bacteriologically sterile in two-thirds of the cases. After the tube is passed from the mouth into the stomach and a vertical banded gastroplasty is carried out, the stomach is sterile in only one-third of the cases. In other words, the introduction of a tube from the mouth caused one-half of the previously sterile stomachs to harbor bacteria.

I felt this evidence explained some of the infections that occur after bariatric surgery where there is no known leak. I also felt it was good to give prophylactic antibiotics to patients undergoing bariatric surgery. It was interesting that a show of hands at the conference last year disclosed the majority of bariatric surgeons to be using antibiotics. Some were using antibiotics preoperatively, but many were not. I felt it would be interesting to carry out studies to see if the administration of antibiotics the day before operation would help reduce the contamination in the stomach.

The various bacteria in the saliva, stomach, small intestines, and colon of normal people have been the object of many studies. Generally, the stomach is considered to be sterile in most fasting, normal people; only in patients with gastric achlorhydria can any bacterial colonization of the stomach be seen. With the advent of widespread Cimetidine usage and antacids, there has been a change in the bacterial colonization of the stomach. Gastric acidity apparently influences the passage of bacteria from the mouth to the intestines. In people with free gastric acid, the upper small intestine is virtually free from bacteria, except after a meal.¹

In 1904, Hewetson reported Staphylococcus aureus planted into the stomach would die in 30 to 45 minutes. He also reported that it takes about twice as long to kill the Pseudomonas aeruginosa in the same situation. He discounted a 50% positive-culture rate of gastric specimens taken from patients during operative procedures as contaminants.²
Pettenkoffer demonstrated the gastric acid barrier by swallowing cholerae organisms before and after neutralizing his gastric acids. His stools were negative for cholerae organisms if the stomach was acidic, but if the stomach acidity was neutralized, he suffered diarrhea, and the stools were positive for cholerae organisms. He concluded that gastric organisms are inconsequential in an acidic environment.\(^3\)

The status of the bacterial flora of the stomach has been of great interest to surgeons because of the incidence of sepsis after operations on the stomach. In 1980, LoCicero and Nichols reviewed 254 gastro-duodenal operations at Charity Hospital in New Orleans over a time span of three years. Forty-one septic complications occurred in 30 patients. Of these 30 patients, 22 had either compromised gastric acidity or motility (obstruction of gastrojejunostomy) at the time of the operation. The authors felt that these two factors were most significant in controlling the organisms that reach the stomach from swallowed saliva or by reflux through the pylorus. The organisms most frequently causing infection after gastroduodenal operations are endogenous to the stomach and include aerobic, gram-negative bacilli, and oral, penicillin-sensitive aerobes. They felt that prophylactic antibiotics were probably not indicated in patients who had normal gastric bacterial inhibitory factors, but, perhaps, they were indicated in operations for bleeding and/or obstructing duodenal ulcers, gastric ulcers, or malignancies.\(^4\)

Further double-blind studies by LoCicero and Nicholas concluded that a short-term antibiotic prophylaxis in patients undergoing gastroduodenal surgery for bleeding duodenal or gastric ulcers or malignancies was very valuable.\(^5\)

For the past several years, we have performed over 1200 gastric operations for morbid obesity. The Center for Surgical Treatment of Obesity notes that the incidence of intra-abdominal infection is 0.0% to 3%, leaks of all types average 0.0 to 3%, and the mortality is from 0.0 to 4%.\(^6\) Inasmuch as the stomachs of these patients do not fit into any other categories under "risk," as outlined by LoCicero et al, we were unable to explain the incidence of wound infection. We considered that the thickness of fat in the abdominal wall was conducive to a high incidence of infection as a consequence of serum accumulation in the wound. We postulated that some of these infections might have been
introduced by the oral cavity of the patient at the time we placed a tube from the mouth into the stomach.

Two of our postoperative gastroplasty patients developed streptococcal peritonitis and died. At autopsy, we could find no leakage from any portion of the gastrointestinal tract. The pathologists tested the stomachs under pressure and did not find any blow-out. To further define the cause of these two cases of streptococcal peritonitis following gastroplasty without leakage from the GI tract we cultured the stomach flora from a gastrotomy at the time of surgery.

In the course of a vertical banded gastroplasty (Mason technique), the esophagogastric juncture is surrounded by a Penrose drain. A 34F tube is then inserted into the stomach from the oral cavity prior to the gastroplasty, but after the patient is asleep (Fig. 1). After this tube has been inserted, a buttonhole is then removed, using the EEA stapling device, from near the lesser curvature of the stomach about 9 cm distal to the cardia.
This permits the firing of two TA-90 staple cartridges vertically from the buttonhole to the left of the esophagogastric juncture. The outlet of the narrow pouch is then banded with a nonabsorbable, nonreactive material to maintain its integrity (Fig. 2).

Figure 2

Cultures were taken from the stomach by injecting saline into it through a gastrostomy incision prior to the passage of a 34F tube from the mouth, and cultures were again taken after the completion of the vertical banded gastroplasty, but prior to closure of the abdominal wound. The cultures were taken by inserting a 20F catheter through a small gastrostomy incision and flushing an ounce of saline into the fundus of the stomach. This was then aspirated and cultured.

RESULTS

Group A: In eight patients the stomach was sterile prior to the passage of the tube from the mouth and was also sterile following the completion of the operation (Table 1).

Group B: In nine patients organisms were cultured from the stomach prior to the passage of the tube, and these were noted to be the same organisms cultured after the passage of the tube.
Group C: In eight patients the stomach was sterile before the passage of the tube but was unsterile after the passage of the tube and the completion of the operation.

Table 1
RESULTS

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<th>Group</th>
<th>Pre-Gastroplasty</th>
<th>Post-Gastroplasty</th>
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<tr>
<td>Group A</td>
<td>Sterile and</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>remain sterile</td>
<td>8</td>
</tr>
<tr>
<td>Group B</td>
<td>Contaminated and</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>remain contaminated</td>
<td>9</td>
</tr>
<tr>
<td>Group C</td>
<td>Sterile and</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>change to</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>contaminated</td>
<td></td>
</tr>
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</table>

We assumed that the nine cases contaminated before the passage of the tube were caused by swallowing of saliva before or during the anesthesia, and the oral secretions were not sterilized in the stomach. Perhaps there was achlorhydria, either permanent or temporary, owing to the use of anesthetic agents and other drugs, or from other causes. Perhaps not enough time had elapsed for the stomach to sterilize the saliva. We were impressed by the eight patients that had a negative culture prior to the passage of the tube only to have a positive culture after passage.

EXPERIMENT

In 1983 and 1984, we took a number of cultures of the stomach before and after the introduction of the standard tube used in vertical banded gastroplasty. About half of the patients were given 1 gm of Duricef (Cefadroxil) at 8 A.M. and 4 P.M. the day after operation.

We were reluctant to treat people longer than this for a number of reasons:

1. Compliance is always difficult to assess and most studies indicate that people do not take the tablets as often as they are instructed.

2. We were not anxious to use any medication for a long time because of the side effects of any antibiotic therapy. We
remember well the days in which Aureomycin was used in the preparation of the colon.

A standard procedure was to give 3 gm daily for four days. Although cultures of the colon were nearly sterile after this treatment regimen, the incidence of membranous colitis suddenly became high, and in one three-month period at one institution with which I was associated, 13 people suffered this complication, and all died. Therefore, I felt that a rather anoxious medicine that would have the ability to kill the normal flora in the mouth which are brought into the stomach during intubation might be a good model. We have incorporated the patients in a new study that were not given antibiotics with the numbers that we had from last year. The studies were rather similar in 1983-84 compared to 1982-83. The numbers are reassuring since there is a larger group.

In the patients who were given oral antibiotics prior to operation, we were not impressed with the results as being significantly better although there is some suggestion that they might be of some help.

We will continue to use oral antibiotics the day before surgery in our study, and perhaps in another year, we will have more definite conclusions. At the present time, we do not think that antibiotics have changed remarkably the incidence of contamination of the stomach.

ORGANISM

The predominant cultured organisms were considered to be oral contaminants (Table 2). The preponderance of alpha hemolytic streptococcus is of great interest since this was the organism identified in the two patients who died after gastroplasty without leak.

<table>
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<th>CULTURED ORGANISMS</th>
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<tr>
<td>ALPHA HEMOLYTIC STREP SP.</td>
<td>19</td>
</tr>
<tr>
<td>CANDIDA SP.</td>
<td>3</td>
</tr>
<tr>
<td>DIPHTHEROID SP.</td>
<td>1</td>
</tr>
<tr>
<td>NIESSERIA SP.</td>
<td>6</td>
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<tr>
<td>STAPH. SP.</td>
<td>4</td>
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<td>CORYNEBACTERIUM SP.</td>
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<td>1</td>
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<td>ENTEROBACTERIUM LEWTONI</td>
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We suggest that passage of the tube from the oropharynx to the stomach prior to or during operation may carry some danger of infection since it passes through a contaminated oral cavity. Perhaps we should consider this hazard and question the necessity for tube passage prior to operation on the stomach. Needless to say, it is necessary in cases of obstructed stomach, perforated stomach or duodenum, and in gastric bleeding. In uncomplicated operations of the stomach, we might forgo this luxury.

PROPHYLAXIS

We have routinely placed gastroplasty patients on prophylactic antibiotics just prior to the time of surgery. We have used a broad spectrum antibiotic, such as Ticar, just before the induction of anesthesia. In patients who are sensitive to the penicillins, we have used other broad spectrum antibiotics, most frequently Keflin. We have not been plagued with wound infections since instituting this regimen.

BIBLIOGRAPHY
### RESULTS - NO PREOPERATIVE ANTIBIOTICS

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<td></td>
</tr>
<tr>
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<td>17</td>
<td>(31%)</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
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<td></td>
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<tr>
<td>Contaminated and remain contaminated</td>
<td>16</td>
<td>(30%)</td>
</tr>
<tr>
<td><strong>Group C</strong></td>
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<tr>
<td>Sterile and change to contaminated</td>
<td>21</td>
<td>(39%)</td>
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70% sterile prior to intubation

#### COMPOSITE
1982-83
1983-84

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### RESULTS - NO PREOPERATIVE ANTIBIOTICS

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<td><strong>Group A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sterile and remain sterile</td>
<td>9</td>
<td>(31%)</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
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<td></td>
</tr>
<tr>
<td>Contaminated and remain contaminated</td>
<td>7</td>
<td>(24%)</td>
</tr>
<tr>
<td><strong>Group C</strong></td>
<td></td>
<td></td>
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<tr>
<td>Sterile and change to contaminated</td>
<td>13</td>
<td>(45%)</td>
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</tbody>
</table>

76% sterile prior to intubation

1983-84
RESULTS DURICEF (CEFADROXIL)

1 gram 8AM & 4PM day prior to surgery

<table>
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<th>Group</th>
<th>Description</th>
<th>Pre-Gastroplasty</th>
<th>Post-Gastroplasty</th>
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<tr>
<td>Group A</td>
<td>Sterile and remain sterile</td>
<td>12 (44.4%)</td>
<td>12</td>
</tr>
<tr>
<td>Group B</td>
<td>Contaminated and remain contaminated</td>
<td>12 (44.4%)</td>
<td>12</td>
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<tr>
<td>Group C</td>
<td>Sterile and change to contaminated</td>
<td>3 (11.1%)</td>
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55% sterile prior to intubation

1983-84
METABOLIC CHANGES IN BARIATRIC SURGERY PATIENTS
George S. Cowan, Jr., M.D., W. Potter, M.D., and E. Golden, M.D.

"Different" metabolic characteristics have been speculatively attributed to morbidly obese patients as a group. We postulated that they could become more evident following the stress of bariatric surgery and its longer-term metabolic-nutritional consequences. The differences found may, in part, explain the 24-month graphic plot trends which seem to be very similar following bariatric surgery, regardless of procedure.

Using a metabolic cart with dedicated computer which, along with other values, measures on-line oxygen consumption ($V_{O2}$), carbon dioxide production ($V_{CO2}$), and 18-hour fasting, early morning studies were performed in four morbidly obese patients before, one week following and at monthly intervals after vertical banded gastroplasty. At each time, 24-hour urinary urea Nitrogen determinations were made allowing calculations of fat, protein and carbohydrate contributions to overall energy expenditure at one- and three-minute intervals during each metabolic cart study. Three-hour glucose tolerance tests with simultaneous metabolic cart measurements were performed preoperatively and at a six-month interval postoperatively. Preoperatively, resting energy expenditures (REE) were approximately 20% higher than predicted by the Harris-Benedict equations. The preoperative respiratory quotients (R.Q.) were lower than the normal fasting values and ranged from 0.68 to 0.73 (normal approx. 0.8-0.85). One week, one month and two months after operation, all but one of these patients' R.Q.s ranged from 0.58 to 0.65. Double checks of the equipment system indicated that these figures were reliable. The one other patient, the only male and only 'super-obese' patient, had an R.Q. that remained at approximately 0.7. Glucose and insulin curves were reflected in the energy expenditure, $V_{O2}$, $V_{CO2}$ and R.Q. changes in the metabolic cart calculations during the three-hour glucose tolerance tests.

It is postulated that these patients' abnormal R.Q.s will rise towards normal at the point where the weight loss curve becomes less steep between six and 12 months after operation. This technique, if validated by further similar studies on bariatric patients, may become an important tool in the metabolic and nutritional pre- and postoperative evaluation of these patients.
The relationship of gallbladder disease and obesity is universally unknown. Nowhere is this relationship so obvious as it is in working with morbidly obese patients. The incidence of gallbladder disease in the general population is reported to be anywhere from 5% to 20%. Of course this incidence varies with age, sex, nationality and especially, weight. Madura found a 43% incidence in his jejunal ileal bypass patients. Rimm found a 29% incidence in those women 100% over ideal weight in his study of women in the Tops organization.

This study of morbidly obese patients undergoing gastric partitioning procedures is meant to show that the true incidence of gallbladder disease in the morbidly obese patient is much higher than is currently thought and, in fact, approaches 80%. Nine hundred eighty patients undergoing gastric partitioning surgery from January 1976 to May 1984 were selected for this study from our gastric bypass series. Excluded were all previous jejunal ileal bypass patients and patients who had their original gastric bypass by another surgeon. Nine hundred fifty-one patients had gastric bypass with gastrojejunostomy and 29 had gastroplasties in the manner of Gomez. The age range was 14 to 63 years (mean, 34.1). The weight range was 160% to 431% of ideal weight (mean, 219.6%). There were 915 women and 65 men (ratio, 14:1).

These patients can be divided into two groups. Group A includes 260 patients operated on prior to October 21, 1980 and Group B consists of 720 patients operated on since October 21, 1980. The difference in the two groups is as follows: gallbladders were removed from patients in Group A only if x-rays or sonograms were positive or if stones were palpated during bypass surgery. Patients in Group B underwent cholecystectomies also if there were adhesions to the gallbladder and if the gallbladder had obvious cholesterolosis or other abnormalities.

In Group A, the incidence of gallbladder disease was 50.4%. Twenty percent of patients had cholecystectomies prior to bypass, 12.6% had simultaneous gallbladder removal, and so far, 18.1% have undergone cholecystectomy after bypass. In Group B, the overall incidence of gallbladder disease is 61.4% with 21% before bypass, 37.9% simultaneous,
and 2.8% after bypass. If both groups are combined, the overall incidence of gallbladder disease is 58.7% (20.7% before bypass, 31.1% simultaneous and 6.8% after bypass).

In Group A, 24 patients were found to have adhesions to the gallbladder, but negative x-rays and no palpable stones. Today these gallbladders would have been removed. Already, six of the 24 patients have had cholecystectomy or positive x-rays. In the entire series, 128 patients have had adhesions and 49 had cholesterolosis. Dividing the groups according to race, we found a much higher incidence of gallstones in Caucasians than in Blacks. Hispanics have a higher incidence than Blacks, but their numbers are too small to be significant.

The relationship of age to gallbladder disease is widely known. The incidence approaches 58% by ages 30 to 39 years and reaches almost 70% past age 50. I'm sure that as time goes on, the overall incidence of gallbladder disease in this series will also approach 70%, and indeed probably already is, if one takes into account those patients lost to follow-up study. The degree of morbid obesity does not appear to affect the incidence of gallbladder disease.

Since there have been few reports in the literature to date on the significance of early gallbladder abnormalities found at the time of surgery, the most interesting results emanate from Group B. Of equal interest is the rapidity at which gallstones can develop and cause symptoms.

TWO CASE STUDIES

Case one: A 26-year-old Caucasian woman underwent gastric bypass on May 27, 1981. She was five feet, nine inches tall and weighed 261 lbs. She was felt to be 116-lbs overweight or 180% of ideal weight. She had a negative gastrointestinal history and negative oral cholecystogram and sonograms prior to operation. During gastric bypass her gallbladder appeared normal even under transillumination of its wall. She was discharged on June 3, 1981. On July 13, 1981 she returned complaining of right upper-quadrant pain and was tender in that area.

She was readmitted to the hospital on August 2, 1981 with recurrent severe right upper-quadrant pain. She also complained of nausea and vomiting. A sonogram revealed gallstones which were confirmed by oral
cholecystogram. She underwent cholecystectomy on August 4th and multiple small stones were found.  

Case two: A 15-year-old Native American girl underwent gastric bypass on April 11, 1981. A preoperative oral cholecystogram did not visualize, but the sonogram was normal. She had a negative gastrointestinal history. At the time of bypass, there were adhesions to her gallbladder, but no palpable stones and positive transillumination. Because of her age, we elected not to perform cholecystectomy.  

On September 14, 1981 she was admitted to the hospital with acute upper abdominal pain. Her bilirubin level was 1.4, and amylase was 1437 (normal 5-75). An ultrasound study now revealed cholelithiasis. On September 17, 1981 she was taken to surgery and cholecystectomy performed. The gallbladder contained numerous 1- to 5-mm cholesterol-type "mulberry" stones and the gallbladder wall was definitely inflamed.  

In retrospect, cholecystectomy should have been done simultaneously with the bypass. She was the only patient in Group B with gallbladder adhesions not to have simultaneous cholecystectomy.  

These are the most extreme cases to date, but other patients have developed gallstones as early as six to nine months after gastric bypass. All but two of the gallbladders removed from patients in Group B were abnormal. Most specimens showed cholesterolosis, cholesterol polyps, Rokitansky-Aschoff sinuses or intramural infiltration of PMNs.  

Adhesions to the gallbladder found at time of abdominal surgery for other reasons have always been of interest to me. They must represent past inflammation of the gallbladder yet no stones were ever palpated. After performing 270 bypasses and noting this phenomenon in about 25 patients, we decided to remove such gallbladders beginning in October 1980, taking the chance that some would be normal. Despite my concern, we were very surprised to find disease in all but two specimens.  

These findings have led me to believe that the entire theory as to etiology of cholecystitis needs revamping. It is a well known fact that morbidly obese patients have a higher percentage of lithogenic bile than similar nonobese patients. It has also been shown that obesity is characterized by an excessive hepatic secretion of cholesterol which
results in supersaturated bile, and thus predisposes to gallstone formation.

During active weight loss, gallbladder bile saturation does not decrease, and may, in fact, increase. These findings are probably due to increased mobilization of adipose tissue cholesterol into the biliary tree and may account for increased bile lithogenicity during active weight loss. In this study, this increased bile lithogenicity during active weight loss probably accounts for the rapid development of symptomatic gallstones in the two cases presented (case one lost 52 lbs in two months, and case two, 78 lbs in five months) and in other postoperative patients. Once a constant reduced weight is achieved, gallbladder bile is consistently less saturated with cholesterol than before weight loss.

Small, et al, theorize a five-part process in the development of cholesterol stones and cholecystitis. In step 5, Dr. Small states that "macroscopic stones cause symptoms by initiating cholecystitis." Whereas this may be true in some cases, I believe that our finding of minimal inflammation in acalculous gallbladders, often in association with cholesterolosis, points to a different etiology of some, if not most, cases of cholecystitis.

It seems that cholesterolosis plays an important part in cholecystitis, but in the usual gallbladder removed for symptomatic cholecystitis, the mucosa is so thickened and inflamed that most traces of cholesterolosis are gone. I theorize that cholesterolosis has a direct causal relationship with stones and inflammation, and that inflammation may occur first, more often than not. I have seen an inflamed gallbladder with cholesterolosis without stones in a 21-year-old white woman who was not obese and never had been. Her x-ray studies revealed a degree of dyskinesia of the gallbladder itself. Perhaps dyskinesia is the initial step in the development of cholecystitis, resulting in stasis, possible bacterial growth and cholecystitis. Also cholesterol polyps are often found early, but usually are rare in chronically inflamed gallbladders. I feel that these polyps may outgrow their circulation, drop off the gallbladder wall and act as the nidus for stone formation and/or inflammation.
These theories are difficult, if not impossible to prove, but at least may explain the cases of asymptomatic acalculous cholecystitis found in about 20% of morbidly obese patients to date. Although 20% seems very high, it is less than the 33% of patients reported by Madura who had lithogenic bile without calculi and who he felt were therefore at risk to develop future symptomatic gallbladder disease. Adding this 33% at risk to the 43% who actually had calculi yields 76%, a figure very close to the 69% of morbidly obese patients over 50 years who had either prior or simultaneous cholecystectomy in the series to date. One should also note that the 18.1% rate of post-bypass cholecystectomies in Group A is not static and will of course increase, thereby increasing the percentage in the entire series. Taking into account the 30% of patients lost to follow-up study, the overall incidence of gallbladder disease in the morbidly obese probably approaches 70%.

All these facts bring up an important question. Should all morbidly obese patients undergoing bypass have cholecystectomy? This was first suggested in 1972 by Barber and again by Madura in 1979. The morbidity of cholecystectomy has been nonexistent in our series and I believe that perhaps cholecystectomy should be performed in all patients undergoing surgery for morbid obesity. It would definitely save the majority of patients the risks and discomforts of another major abdominal operation and would result in a minimal risk for those who happened to have normal gallbladders. In my practice, I still don't remove all gallbladders, but I probably should since my postoperative cholecystectomy incidence is slowly increasing in both Groups A and B.

It is clear from our data that gallbladder disease in the morbidly obese is far more prevalent than heretofore reported. Madura found 43% in his jejunoileal bypass (JIB) patients and another 33% at risk with lithogenic bile. It is probably also true that while gallbladder stones are considered as an accepted side effect of JIB, the incidence is no higher than in the general morbidly obese population and that the JIB, in itself, is not lithogenic despite all theories so far expounded.

I believe that our data also illustrates the fact that any abnormality of the gallbladder, whether it be adhesions, cholesterolosis, etc, should be treated aggressively by cholecystectomy in order to save the patient another operation in the future. Even in patients who are
not obese, adhesions to the gallbladder in the absence of previous RUQ surgery or disease should be considered as a sign of early gallbladder disease and treated accordingly by cholecystectomy. If one looks at the 18.1% incidence of post-bypass gallbladder disease in Group A, most of these people could have been spared another operation by a more aggressive approach to a minimally diseased gallbladder.

Many theories as to etiology of gallbladder disease have been expounded in the literature and we are making no claims as to the accuracy of any of them. We have only summarized our data and have presented our conclusions.

REFERENCES
CHOLECYSTECTOMY IN THE MORBIDLY OBESE
UNDERGOING GASTRIC PARTITIONING
AND THE RELATIONSHIP TO AGE

AGE GROUPS

YEARS | PRE-BYPASS | SIMULTANEOUS | POST-BYPASS | TOTAL
--- | --- | --- | --- | ---
19 & UNDER | 0% | 0% | 21.1% | 16.7% | 15.8% | 22%
20 - 29 | 13.6% | 14% | 7.6% | 36.7% | 25.8% | 2.3% | 51.6%
30 - 39 | 16.3% | 20.9% | 15.7% | 36.6% | 19% | 3.1% | 57.9%
40 - 49 | 30.2% | 30.9% | 9.4% | 46.7% | 9.4% | 1.4% | 70.1%
50 & OVER | 64.3% | 29.2% | 14.3% | 33.3% | 7.1% | 2.1% | 69.4%
TOTAL | 20.8% | 20.7% | 11.9% | 37.9% | 18.1% | 2.8% | 58.7%
OBESITY SURGERY IN THE HIGH RISK PATIENT

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A series of patients are presented who in the past have not been considered to be candidates for surgery for morbid obesity. It includes those from the following three groups:

Group I. Patients above the age of 60 years.
Group II. Patients with severe pulmonary insufficiency.
Group III. Patients with significant cardiovascular disease.

These patients have undergone vertical banded gastroplasty and have done well. Marked improvement in physiologic function and quality of life has been observed. New criteria for the selection of patients for operation are proposed.